



SWARAJ 744 FE TRACTOR



सत्यमेव जयते

भारत सरकार

कृषि एवं किसान कल्याण मंत्रालय
(कृषि, सहकारिता एवं किसान कल्याण विभाग)
GOVERNMENT OF INDIA

MINISTRY OF AGRICULTURE AND FARMERS WELFARE
(DEPARTMENT OF AGRICULTURE, CO-OPERATION AND FARMERS WELFARE)

केन्द्रीय कृषि मशीनरी प्रशिक्षण एवं परीक्षण संस्थान
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T- 1115/1641/2017

SWARAJ 744 FE- TRACTOR Commercial (Batch)

Manufacturer

: M/s. Mahindra & Mahindra Ltd.
Farm Equipment Sector, Swaraj Division
Phase- IV, Industrial Area, S.A.S. Nagar,
Mohali, Punjab – 160 055



Month: November

Test Report No. T- 1115/1641/2017

Year: 2017



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Type of Test	: COMMERCIAL (Batch)
Test code/Procedure	: IS: 5994-1998 (Reaffirmed in 2009) and IS: 12207-2014.
Period of Test	: December, 2016 to October ,2017
Test Report No.	: T- 1115/1641/2017
Month/Year	: November, 2017



- i) The results reported in this report are observed values and no corrections have been applied for atmospheric and site conditions.
- ii) The data given in this report pertain to the particular machine submitted by the applicant, for tests.
- iii) The results presented in this report do not in any way attribute to the durability of the machine.
- iv) This report should not be reproduced in part or full without prior permission of the Director, Central Farm Machinery Training and Testing Institute, Budni (M.P.)
- v) This is the First batch test report and therefore, should be read in conjunction with the Test Report of base model i.e. "Swaraj 744 FE Tractor" bearing report no. T- 401/821 released in July, 2000 and the supplementary report, "Swaraj 744 FE Tractor" bearing report no. T- 1114/1640/2017 released in November, 2017.

SELECTED CONVERSIONS

SELECTED CONVERSIONS		
Sl. No	Units	Conversion Factor
1	Force:	
	1 kgf	9.80665 N
		2.20462 lbf
2	Power:	
	1 hp	1.01387 metric hp (Ps) 745.7 W
	1 Ps	735.5 W
	1 kW	1.35962 Ps
3	Pressure:	
	1 psi	6.895 kPa
	1 kgf/cm ²	98.067 kPa = 735.56 mm of Hg
	1 bar	100 kPa = 10 N/cm ²
	1 mm of Hg	1.3332 m-bar

ABBREVIATIONS	
apa	As per applicant
TDC	Top Dead Centre
IS	Indian Standard
LHS /RHS	Left Hand Side/ Right Hand Side
Hg	Mercury
Temp.	Temperature
N.R.	Not recorded
rpm	Revolutions per minute
O.D./I.D	Outer diameter/ Inner diameter
N.A.	Not available/Not applicable
PTO	Power take-off
R.H.	Relative Humidity
SIP	Seat Index Point



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The "Swaraj 744 FE" tractor had undergone "Initial Commercial Test" at this Institute and a test report No. T-401/821 was released in July, 2000. Thereafter, the firm had made modification in the specification of the tractor and permanently incorporated and tested under supplementary test vide test report No. T- 1114/1640/2017, released in November, 2017. Now the applicant has submitted an application vide letter No. 20/1606076 dated 29.06.2016 for Batch testing of "Swaraj 744 FE".

All necessary tests as per table-1 of clause 6.0 of IS : 5995 - 1998 (Reaffirmed in 2009) were carried out and test report released as under.

Manufacturer	:	M/s. Mahindra & Mahindra Ltd. Farm Equipment Sector, Swaraj Division Phase- IV, Industrial Area, S.A.S. Nagar, Mohali, Punjab – 160 055
Test requested by	:	The manufacturer
Selected for test by	:	The testing authority
Place of running-in	:	At manufacturer's works
Duration of said running-in, (h):		
- Engine	:	28
- Transmission	:	32
Method of Selection	:	The test sample was selected randomly out of Seven tractors from the production line by the representative of testing authority.

1. SPECIFICATIONS

1.1 Tractor:	
Make	: Swaraj
Model	: 744 FE
Brand name	: Swaraj
Type	: Four wheel, Two wheel driven, Unit construction, General Purpose, Agricultural Tractor
Year of manufacture	: WY (i.e. 2016)
Chassis number	: WYCN45922957873
Country of origin	: India
1.2 Engine:	
Make	: M/s Swaraj Engines Ltd.
Model	: RB 30 TR
Type	: Four stroke, water cooled, direct injection, diesel engine
Serial number	: 43.3009/SWN25221
Year of manufacture	: 2016
Country of origin	: India
1.2.1 Engine speed (rpm), (Manufacturer's recommended production settings):	
- Maximum speed at no load	: 2100 to 2200
- Low idle speed	: 580 to 700
- Speed at maximum torque	: 1200 to 1600
Rated speed, (rpm):	
- For PTO use	: 2000
- For drawbar use	: 2000



1.3	Cylinder & Cylinder Head:	
	Number	: Three
	Disposition	: Vertical, inline
	Bore/stroke, (mm)	: 110 / 110
	Capacity as specified by the applicant, (cc)	: 3136 (apa)
	Compression ratio	: 18.5 (± 0.5) : 1
	Type of cylinder head	: Individual
	Type of cylinder liners	: Wet replaceable
	Type of combustion chamber	: Cavity torroidal on piston crown
	Arrangement of valves	: Overhead
	Valve clearance (cold/hot):	
	- Inlet valve, (mm)	: 0.25 – 0.30
	- Exhaust valve, (mm)	: 0.30 – 0.35
1.4	Fuel System:	
	Type of fuel feed system	: Gravity and force feed
1.4.1	Fuel tank:	
	Capacity, (l)	: 50.0
	Location	: Above clutch housing
	Provision for draining of sediments/ water	: Not Provided
	Material of fuel tank	: Metallic
1.4.2	Water separator:	
	Make	: alert
	Type	: Transparent, gravity separation, inverted funnel
	Location	: Between fuel tank and primary fuel filter
	Capacity(l)	: 0.50
1.4.3	Fuel feed pump:	
	Make	: Bosch, India
	Type	: Plunger
	Model/Group combination No.	: FP/KS22AD62 (apa), 9440030029 (apa)
	Provision of sediment bowl	: Provided (metallic)
	Method of drive	: Through FIP of camshaft
1.4.4	Fuel filters:	
	Make	: Bosch, India
	Model/Group combination No.	: F 002 H20 105
	Number	: Two
	Type of elements:	
	- Primary	: Cloth
	- Secondary	: Paper
	Capacity of final stage filter, (l)	: 0.43
1.4.5	Fuel Injection pump:	
	Make	: Bosch, India
	Model/Group combination No.	: F 002 A0Z 469, PES3A90D320RS2000
	Type	: Plunger, inline
	Serial number	: 65876487
	Method of drive	: Through timing gears



- 1.4.6 Fuel injectors:**
- Make : Bosch, India
- Model/Group combination No.: :
- Holder Number : F002 C70 552
- Nozzle Number : DSLA 154 P 1542
- Type : Multi hole (four holes)
- Manufacturer's production pressure setting, (MPa) : 25.0 + 0.8
- Injection timing : 13 ± 1 degree before TDC
- Firing order : 1 – 2 – 3
- 1.4.7 Governor:**
- Make : Bosch, India
- Model/Group combination No. : RSV 375...1000A1C1377R
- Type : Mechanical, centrifugal, variable speed
- Governed range of engine speed, (rpm) : 580 to 2200
- 1.5 Air intake system:**
- 1.5.1 Pre-cleaner:**
- Make : Swaraj
- Type : Cyclone with transparent dust collector
- Location : On the top of main air cleaner
- 1.5.2 Air cleaner:**
- Make : Sietz
- Type : Oil Bath
- Location : On LHS of engine, outside the bonnet
- Range of suction pressure at maximum power, (kPa) : 3.0
- Capacity of oil bath : 0.70
- Maintenance schedule : After 8 to 16 hours in dusty condition and 50 hours of operation in normal condition.
- 1.6 Exhaust System:**
- Type of silencer : Updraft, cylindrical
- Position of silencer outlet with respect to SIP, (mm):**
- Vertical : 900
- Longitudinal : 1450
- Lateral : 520 (on RHS)
- Range of exhaust gas pressure at maximum power (kPa) : 4.9 to 6.5
- Provision of spark arresting device : Not provided
- Provision against entry of rain water : A bend is provided at the top of silencer
- 1.7 Lubricating system:**
- Type : Forced feed-cum-splash
- Oil sump capacity,(l) : 6.50
- Total lub oil capacity, (l) : 7.2
- Oil change period : First change after 50 hours and subsequently after every 250 hours of operation
- Type of cooling device, (if any) : Provided



	Details of oil cooler:	
	Make	: Not available
	Model	: Not available
	Type	: Three circular plate type heat exchanger
	No. of plates & diameter,	: 03 & 93.0 mm
	Location	: On LHS of cylinder's block into the water jacket
1.7.1	Filters:	
	Make	: Not available
	Type	: Full flow, Spin-on throw away, paper element
	Number	: One
1.7.2	Pump:	
	Type	: Gear
	Method of drive	: Through timing gears
	Pressure release setting, (kPa)	: 550 ± 50 (apa)
	Minimum permissible pressure, (kPa)	: 49 (apa)
1.8	Cooling system:	
	Type	: Forced water circulation
	Brand name of the coolant	: Not applicable
	Coolant water ratio	: Not applicable
1.8.1	Details of Pump	: Centrifugal with semi open impeller having six vanes of 78.9 mm diameter and driven through crankshaft pulley by a cogged 'V'-belt.
1.8.2	Details of fan	: Suction type having polypropylene blades and 374 mm diameter, and mounted on water pump shaft.
	Means of temperature control	: Thermostat
	Bare radiator capacity, (l)	: 2.7
	Coolant expansion tank capacity,(l)	: 0.9
	Total coolant capacity, (l)	: 7.70
	Radiator cap pressure, (kPa)	: 88
1.9	Starting System:	
	Type	: 12 V, DC, Electrical
	Aid for cold starting	: None
	Any other device provided for easy starting	: None
1.10	Electrical System:	
1.10.1	Battery:	
	Make and model	: Exide Espress & MHD1000
	Type	: Lead acid
	Capacity and rating	: 12V, 100 Ah at 20 hours discharge rate
	Location	: On RHS of clutch housing in separate metallic box.



- 1.10.2 Starter:**
 Make : Lucas – TVS (apa)
 Model : SM 114
 Type : Pre-engaging, solenoid operated
 Power rating : 12V, 1.9 kW
 Serial number : Not available
- 1.10.3 Generator:**
 Make : Lucas - TVS
 Model : A115
 Type : Alternator
 Serial number : Not available
 Output rating : 12V, 36 A
 Method of drive : Through crankshaft pulley by a cogged "V" belt
- 1.10.4 Voltage regulator** : In-built with alternator
- 1.10.5 Details of lights:**

Description	No. & capacity of bulb	Height of the centre of beam above ground level, (mm)	Size, (mm)	Distance between centre of the beam and outside edge of tractor at standard rear track setting, (mm)
Front Lights:				
- Head lights	2, 12V, 35/35W	1240	130 x 100	775
- Parking lights	2, 12V, 5W	1310	65 x 65	190
- Turn cum hazard light	2, 12V, 21W	1310	70 x 65	125
Reflectors (white)	2	1310	30 x 55	230
Rear lights:				
- Tail-cum-brake light	2, 12V, 21/5W	1330	65 x 65	240
- Turn cum hazard light	2, 12V, 21W	1330	70 x 65	170
- Plough light (on RHS mudguard)	1, 12V, 35W	1485	125 Φ	200
- Reflectors (Red)	2	1330	30 x 55	280
- Registration plate light (RHS)	Part of rear light assembly			

- 1.10.6 Main switch** : Key turn type, having three position viz:
 i) OFF
 ii) 'Circuit' ON
 iii) START
- 1.10.7 Light switch** : Rotary type having four positions viz.
 i) OFF
 ii) Parking lights + Dash board lights 'ON'
 iii) Head lights (short beam) + (ii)
 iv) Head lights (long beam) + (ii)
- 1.10.8 Horn:**
 Make : Minda
 Type : 12 V, 2B, Electromagnetically vibrated diaphragm
 Location : In front of radiator, under the bonnet



1.10.9 Fuse box : Contains four number of fuses of following capacity:

Capacity	15 A	10 A
No. of fuse	01	03

1.10.10 Details of other electrical accessories:

1.10.10.1 Starting safety switch : Engine will not start unless the High-Low range shift lever is in neutral position.

1.10.10.2 Flasher Unit:

Make : Interface

Capacity:

- Turn signal : 12V, 21W x 2 + 2W x 1

- Hazard signal : 12V, 21W x 4 + 2W x 2

Flashes/min. : 85

1.10.10.3 Seven pin trailer socket : Provided

1.11 Instrument panel details:

i) Engine speed cum cumulative run hour meter (4 to 24) x 100 rpm

ii) Water temperature gauge (with colour zones)

iii) Fuel level gauge (with colour zones)

iv) Engine oil pressure gauge (with colour zones)

v) Starting switch (key-turn type)

vi) Light switch (Rotary type)

vii) Turn cum hazard indicator

viii) Turn indicator switch

ix) Hazard light switch

x) Head lamp (long beam) 'ON' indicator light

xi) Ampere meter (with colour zones)

xii) Fuel shut-off knob

xiii) Horn push button

xiv) Hand accelerator lever

xv) Steering control wheel

xvi) Rear View mirror

xvii) High low lever neutral indicator

xviii) Trailer engage indicator

1.12 Transmission System:

1.12.1 Clutch:

Make : Luk. India

Type : Dual, dry friction plates

No. of friction plate, (s) : Two

Size, (mm):

Transmission : 279.63 / 165.70 Ø

PTO : 279.49 / 165.59 Ø

Method of operation :

Transmission : By depressing the clutch pedal, half way provided on LHS of operator's seat.

PTO : By depressing the clutch pedal, fully provided on LHS of operator's seat.

1.12.2 Gear box:

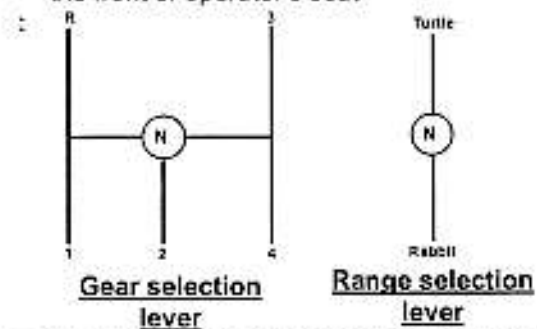
Make : Swaraj

Type : Mechanical, combination with sliding mesh gears and epicyclic high – low range selection unit

**No. of speeds:**

- Forward : 08
- Reverse : 02

Location of gear shifting levers : Main gear shifting lever and range selection gear shifting lever is located in the front of operator's seat

Gear shifting pattern

Oil capacity (l)

: 50.0 (common with differential, rear axle, hydraulic and brake system)

Oil changing period

: After 1600 hours of operation.

1.12.3 Nominal Speed:

Movement	Gear No.	No. of engine revolutions for one revolution of driving wheel	Nominal speed at rated engine speed when fitted with 14.9-28 size tyres 640 mm radius index, (kmph).
Forward	L1	172.61	2.80
	L2	131.28	3.67
	L3	79.03	6.11
	L4	53.90	8.94
	H1	50.12	9.62
	H2	38.04	12.67
	H3	22.90	21.07
	H4	15.62	30.89
Reverse	LR	145.53	3.31
	HR	42.14	11.45

1.12.4 Differential :

Type

: Crown wheel and bevel pinion, with differential unit accommodated inside the differential housing.

Reduction through crown wheel & bevel pinion

: 3.231:1 (42/13 T)

Oil capacity (l)

: 50.0 (common with gearbox, rear axle, hydraulic and brake system)

Oil changing period

: After every 1600 hours of operation

Differential lock:

Not Provided

1.12.5 Rear axle & final drive:

Type

: Bull gear and pinion reduction unit accommodated inside the differential housing

Reduction through final drive

: 4.833:1 (58/12T)

Oil capacity of final drive, (l)

: 50.0 (common with gearbox, differential, hydraulic and brake system)

Oil changing period

: After every 1600 hours of operation

**1.13 Power lift (Hydraulic system):**

- Make : Swaraj
- Type : Open centre, live, ADDC
- No. and type of internal cylinder : One, single acting
- Type of linkage lock for transport : A isolating knob is provided on distributor, when fully tighten acts as transport lock

1.13.1 Hydraulic pump:

- Make & Model : Rexroth
 - Type : Gear
 - Location & drive : On RHS of engine, through timing gears.
 - No. & Type of filter : One, spin on through away
 - Hydraulic oil capacity, (l) : 50.0 (common with transmission and brake system)
 - Oil change period : After every 1600 hours of operation.
 - Provision for external tapping : Provided (A isolating knob is provided on distributor)
- Details of control :**
- i) Position control lever (black).
 - ii) Draft control lever (Red).
 - iii) Isolation valve knob on distributor

Method of draft sensing : Through top link

1.13.2 Three point linkage:

Sl. No.	Observations	As per IS:4468-1997(Part-I) (Cat.I / Cat.II), (mm)	As measured (mm)	Remarks
1	2	3	4	5
I.	Upper hitch points:			
	a) Dia of hitch pin hole	19.30 to 19.50 / 25.70 to 25.90	25.9	Conforms to Cat. II
	b) Width of ball	44.0 (max.) / 51.0 (max)	51.0	Conforms to Cat. II
II.	Lower hitch points:			
	a) Dia of hitch pin hole	22.40 to 22.65 / 28.70 to 29.00	29.0	Conforms to Cat. II
	b) Width of ball	34.8 to 35.0 / 44.8 to 45.0	44.9	Conforms to Cat. II
III.	Lateral distance from lower hitch point to centre line of tractor	359 / 435	359	Conforms to Cat. I
IV.	Lateral movement of lower hitch points	100 (min) / 125 (min)	260	Conforms to Cat. I & II
V.	Distance from end of power take-off to centre of lower hitch point (lower links in horizontal position)	450 to 575 / 550 to 625	530	Conforms to Cat. I
VI.	Transport height	820 (min) / 950 (min)	985	Conforms to Cat. I & II
VII.	Power range (Without force)	560 (min) / 650 (min)	650	Conforms to Cat. I & II
VIII.	Leveling adjustment	100 (min) / 100 (min)	320	Conforms to Cat. I & II
IX.	Lower hitch point tyre clearance	100 (min) / 100 (min)	200	Conforms to Cat. I & II
X.	Lower hitch point height	200 (max) / 200 (max)	200	Conforms to Cat. I & II

1.13.3 Linkage geometry dimensions [Refer Fig.-1(A)]:

The following are dimensions observed, corresponding to 640 mm as tyre dynamic radius index:

Sl. No.	Parameter	Notation	Dimension or range, (mm)	Setting used during test, (mm)
1.	Length of lower link	A	780	780
2.	Length of lift arm	B	235	235
3.	Length of lift rods	C	610 to 725	705
4.	Length of top link	D	500 to 750	535
5.	Distance of lift rod connection point from pivot point of lower link.	E	390 & 450	450
6.	Distance of lower link pivot point from rear wheel axis:			
	-Horizontally	F	110, behind	110, behind
	-Vertically	G	145, below	145, below
7.	Distance of upper link pivot point from rear wheel axis:			
	-Horizontally	H	350, 355 & 355 behind	355, behind
	-Vertically	J	270, 300 & 330 above	300, above
8.	Distance of lift arm pivot point from rear wheel axis:			
	-Horizontally	K	70, forward	70, Forward
	-Vertically	L	370, above	370, above
9.	Height of lower hitch points relative to the rear wheel axis:			
	- In high position	M	140 to 345	210, above
	- In low position	N	- 600 to - 275	440, below
10.	Height of lower link hitch points when locked in transport position	--	210, above	210, above

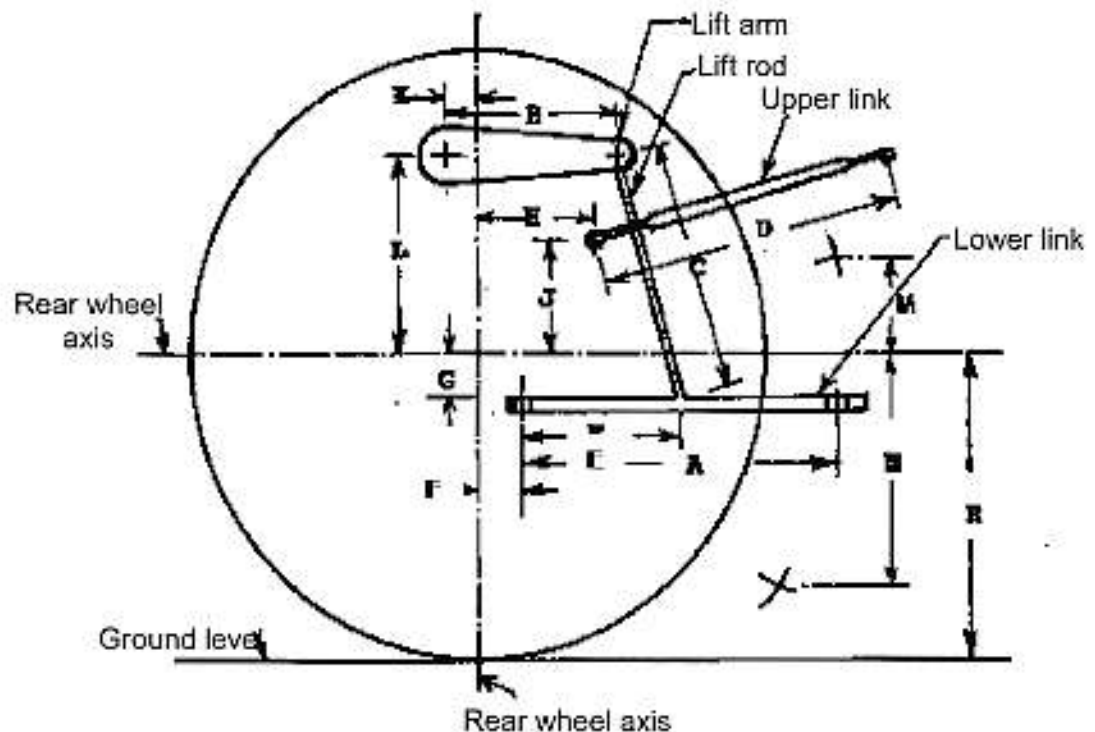


Fig.1 (A): DIMENSIONAL NOTATIONS FOR TABLE OF LINKAGE GEOMETRY



1.13.4 Drawbar:

1.13.4.1 Linkage Drawbar [Refer Fig. 1 (B)]:

Notation	As per IS: 12953-1995 (Cat. I)/(Cat. II) (mm)	As measured, (mm)	Remarks
A	683 ± 1.5 / 825 ± 1.5	684	Conforms to Cat. I
B	75 (min) / 75 (min)	75	Conforms to Cat. I & II
C	30 (min) / 30 (min)	30.3	Conforms to Cat. I & II
D \varnothing	21.79 to 22.00 / 27.79 to 28.00	27.96	Conforms to Cat. II
E	39.0 (min) / 49.0 (min)	54	Conforms to Cat. I & II
F \varnothing	12.0 (min) / 12.0 (min)	12.1	Conforms to Cat. I & II
G	15.0 (min) / 15.0 (min)	16.2	Conforms to Cat. I & II
H \varnothing	25 ± 1 / 25 ± 1	24.84	Conforms to Cat. I & II
J	80 ± 1.5 / 80 ± 1.5	80	Conforms to Cat. I & II
No. of holes	7 / 9	07	Conforms to Cat. I

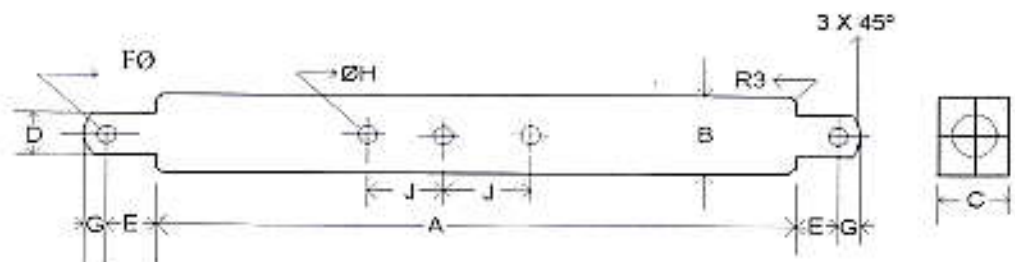


Fig. 1 (B): DIMENSIONAL NOTATIONS FOR LINKAGE DRAWBAR

1.13.4.2	Swinging drawbar	: Not provided
1.13.4.3	Provision to attach trailer brake valve	: Provided
1.14	Power take-off shaft:	
	Type	: Type-I, Semi independent
	Method of engaging	: By a hand lever provided on LHS of operator's seat.
	No. of shaft(s)	: One
	PTO speed corresponding to rated engine speed of 2000 (rpm)	: 653
	Distance behind rear axle, (mm)	: 360
	Engine to PTO speed ratio	: 3.0625 : 1
	Whether the PTO shaft is capable of transmitting the full power of engine	: Yes
	Other speeds corresponding to rated engine speed	: Not applicable



1.14.2 Specifications of Power Take-Off Shaft: [Refer Fig. 2]

Specification	As per IS:4931-1995 (Type-I)	As observed	Remarks
Nominal speed (rpm)	540 ± 10	540 rpm of PTO shaft corresponds to 1654 rpm of engine.	Conforms to Cat. I
No. of splines	6	6	Conforms to Cat. I
Direction of rotation	Clockwise	Clockwise	Conforms to Cat. I
Location	The position of the centre of the end of PTO shaft shall be within 50mm to right or left of the centre line of the tractor	8 mm on LHS	Conforms to Cat. I
Dimensions (mm) (See Fig. 2):			
D \emptyset	34.79 ± 0.06	34.74	Conforms to Cat. I
d \emptyset	28.91 ± 0.05	28.86	Conforms to Cat. I
B \emptyset	29.4 ± 0.1	29.36	Conforms to Cat. I
A \emptyset (Optional)	8.3 ± 0.5	8.68	Does not conform
W	8.69 - 0.09 - 0.16	8.53	Conforms to Cat. I
a	7	7	Conforms to Cat. I
b (Optional)	25 ± 0.5	25.5	Conforms to Cat. I
c	38	38	Conforms to Cat. I
X	30°	30°	Conforms to Cat. I
B	76 (min)	79	Conforms to Cat. I
h	450 to 675	655	Conforms to Cat. I

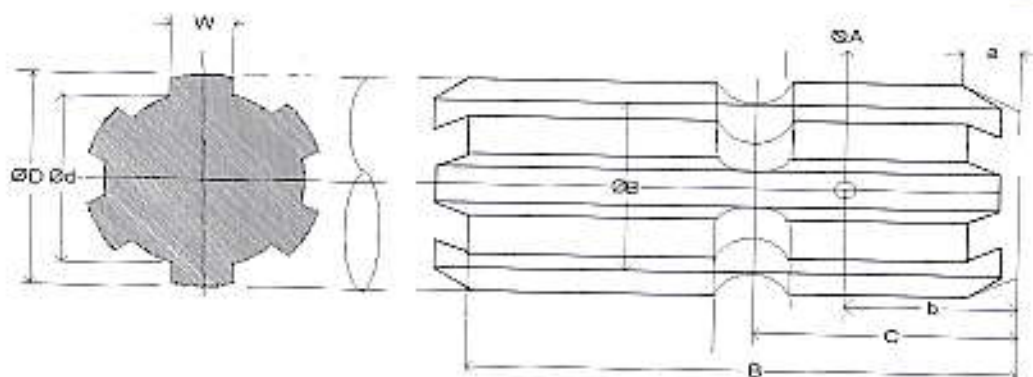


Fig. 2 (a): DIMENSIONAL NOTATIONS FOR TYPE-I POWER TAKE-OFF SHAFT

1.14.3 Power Take-off Master Shield : Provided, Type - I

Dimensions of PTO master shield for type I & II PTO (mm) [Refer Fig. 2(b)]

Specification	As per IS 4931-1995	As observed	Remarks
k	70 (min)	70	Conforms
m	125±5	125	Conforms
n	85±5	80	Conforms
p	285±5	285	Conforms
r	76 (max.)	0	Conforms

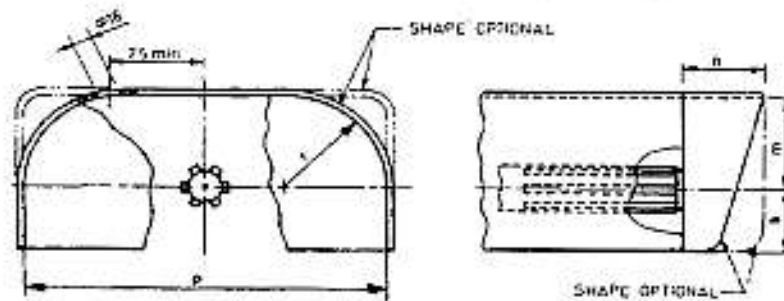


Fig. 2 (b): DIMENSIONAL NOTATIONS OF PTO SHAFT MASTER SHIELD

1.15 Towing hitch:

1.15.1 Front:

Type	: Clevis
Location	: At front of front engine support
Height above ground level, (mm)	: 660
Type of adjustment	: Fixed
Width of clevis, (mm)	: 63.4
Dia of pin hole, (mm)	: 26.3

1.15.2 Rear:

Type	: Clevis
Location	: At rear of transmission housing
Height above ground level, (mm):	
- Maximum	: 815
- Minimum	: 570
No. of position	: 06
- Type of adjustment	: By changing and reversing the position of hitch on its mounting bracket
Distance of hitch point, (mm):	
- From rear axle centre	: 455
- From power take-off shaft end	: 95
Dia of pin hole, (mm)	: 34.7
Width of clevis, (mm)	: 79

1.16 Steering:

Make	: Danfoss
Type	: Hydrostatic (power steering)
Location of control wheel	: On top of gearbox housing
Method of operation	: Manually through steering control wheel
Diameter of steering control wheel, (mm)	: 370
Steering oil capacity, (l)	: 1.50
Lubricant change period	: After every 1600 hours of operation.
Distributor (HSU Unit):	
Make	: Danfoss
Type	: Hydrostatic, open centre
Location	: On top of gearbox housing



	Pump:	
	Make	: Rexroth
	Type	: Gear
	Location	: On front RHS on engine
	Method of drive	: Through timing gears (common to hydraulic pump shaft)
	Hydraulic cylinder:	
	Make	: Not available
	Type	: Double acting, sing connecting
	Location	: On rear LHS of front axle
1.17	Brakes:	
1.17.1	Service Brake:	
	Make	: JMIL
	Type	: Mechanical, multidisc oil immersed
	Location	: On bull pinion shaft, outside differential housing
	No. of discs	: Four (on each wheel side)
	Area of liners. (cm ²)	: 913.0 (on each wheel side)
	Material of liners	: Paper based
	Method of operation	: Independent / combined RHS foot operated
	brake oil capacity, (l)	: 50.0 (common with transmission and hydraulic system)
	Lubricant change period	: After every 1600 hours of operation.
1.17.2	Parking Brake:	
	Type	: Pawl and ratchet arrangement
	Method of operation	: Service brake acts as parking brake when locked in depressed position by a hand lever provided on RHS of foot rest.
1.18	Wheel Equipment:	
1.18.1	Steered Wheel(s):	
	Make	: Good Year
	Number	: Two
	Type of tyre	: Pneumatic, ribbed
	Size	: 6.00 -16
	Ply rating	: 8
	Maximum permissible loading capacity of each tyre at 250 kPa pressure, (kgf)	: 450
	Recommended inflation pressure, kPa :	
	- for field work	: 235.4
	- for transport	: 235.4
	Track width, (mm)	: 1230, 1330 (std.), 1440 & 1530
	Method of changing track width	: Inverting wheel disc and by extending telescopic front axle..
	Make & size of rim	: SSWL, 4.50E x 16
1.18.2	Driving wheel:	
	Make	: Good Year
	Number	: Two
	Type of tyre	: Pneumatic, traction
	Size	: 14.9 - 28
	Ply rating	: 12
	Maximum permissible loading capacity of each tyre at 230 kPa pressure, (kgf)	: 2120



- Recommended inflation pressure, (kPa)**
 - for field work : 98
 - for transport : 108
 Track width, (mm) : 1430, 1420 (std.), 1460, 1540, 1620, 1700, 1740 & 1820
 Method of changing track width : By changing and reversing the position of disc on off-set wheel rim lugs
- 1.18.3 Make & size of rim** : WIL & W13 x 28
Wheel base, (mm) : 2100
 Method of changing wheel base. if any : None
- 1.19 Operator's seat:**
 Make : Not available
 Type : Cushioned with backrest
 Type of suspension : Two Helical springs
 Type of damping : Hydraulic shock absorber
Range of adjustment,(mm):
 - Vertical : Nil
 - Lateral : Nil
 - Longitudinal : ± 65
- 1.20 Provision for safety and comfort of operator:**
1.20.1 Conformity with IS: 12343-1998: (Re-affirmed in March, 2009).
 Operator's seat meets the requirements.
1.20.2 Conformity with IS: 6283 (Part-1) – 2006 (Re-affirmed in March, 2009) & IS: 6283 (Part-2) – 2007 (Re-affirmed in March, 2009):
 Controls are identifiable with symbols meets the requirements.
1.20.3 Conformity with IS:8133-1983 (Re-affirmed in March, 2009):
 Location and movement of various controls meets the requirement.
1.20.4 Conformity with IS: 12239 (Part-1)-1996 (Re-affirmed in February, 2012):
 Meets the requirements of IS:12239 (Part-1)-1996, **except the following:**
 i) Width of foot step is less than the 200mm.
 ii) The spark arrester has not been provided in the exhaust system
1.20.5 Conformity with IS:12239 (Part-2)-1999 (Re-affirmed in March, 2009):
 Meets the requirements of IS:12239 (Part-2)-1999, **except the following:**
 i) The working clearance around the position control lever & and draft control is less than 70 mm.
1.20.6 Conformity with IS: 14683 – 1999 (Re-affirmed in March, 2009) :
 Lighting requirements conform to IS: 14683-1999.
1.20.7 Rear view mirror:
 Rear view mirror is provided
1.20.8 Slow moving emblem : Provided
- 1.21 Labelling of tractor as per IS: 10273-1987 (Reaffirmed in March, 2009):**
Locations of labelling plate:- The labelling plate is riveted on LHS of the gearbox housing and provides the following information:

Name of Manufacturer	Swaraj Division Tractors Mahindra & Mahindra Ltd.
Make	Swaraj
Model	744 FE
Year of manufacture	WY (i.e. 2016)
Engine Number	43.3009/SWN25221
Chassis Number	WYCN45922957873
Maximum P.T.O Power, kW (hp)	30.1
Specific fuel consumption,(g/hph)	265

**1.22 Ballast Mass (kg):**

Particular	As used during drawbar test	As used during field test		As used during haulage test
		Dry land		
Front	C.I. weight	60	60	60
	Water	Nil	Nil	Nil
Rear	C.I. weight	360	180	180
	Water	320	Nil	Nil
Additional weight, if any		Nil	Nil	Nil

1.22.1 Standard ballast if any: **None**

1.23 Masses:

Particulars	Mass of the tractor without operator but with all the liquid reservoirs full, (kg)		
	Front	Rear	Total
i) Without ballast	745	1325	2070
ii) With ballast as used during drawbar performance test	835	1975	2810
iii) With ballast as used during field test (dry land)	850	1490	2340
iv) With ballast as used during haulage test (including trailer hitch, canopy & linkage drawbar)	850	1490	2340

1.24 Overall dimensions:

Condition	Length, (mm)	Width, (mm)	Height, (mm)		Ground Clearance, (mm)
			With exhaust pipe	Without exhaust pipe	
With unballast	3470	1820	2240	1840 (at steering wheel)	435 (Front axle)

1.25 Number of external lubricating points:

- Oiling : Nil
- Grease nipples : 02
- Grease cups : 19

1.26 Colour of tractor:

- Chassis : Smoke grey
- Sheet metal:
- Bonnet : Blue
- Mudguard, Rim & Disc : Cream yellow

2. FUEL AND LUBRICANTS

2.1 Fuel : The High-speed diesel oil supplied by M/s Indian Oil Corporation Limited having density of 0.836 g/cc at 15°C was used.

2.2 Lubricants:

S. No.	Particulars	As recommended by the manufacturer	As used during the test
1.	Engine & air cleaner oil	SAE 30	As recommended
2.	Transmission, Steering housing, Hydraulic and brake system	ELF 2371	Oil originally filled in the tractor systems were not changed
3.	Grease	MP Grease	MP Grease



3. PTO PERFORMANCE TEST

Date(s) of test : 31.01.2017 & 01.02.2017

Tractor run at the Institute prior to start of : 7.23

PTO test (h)

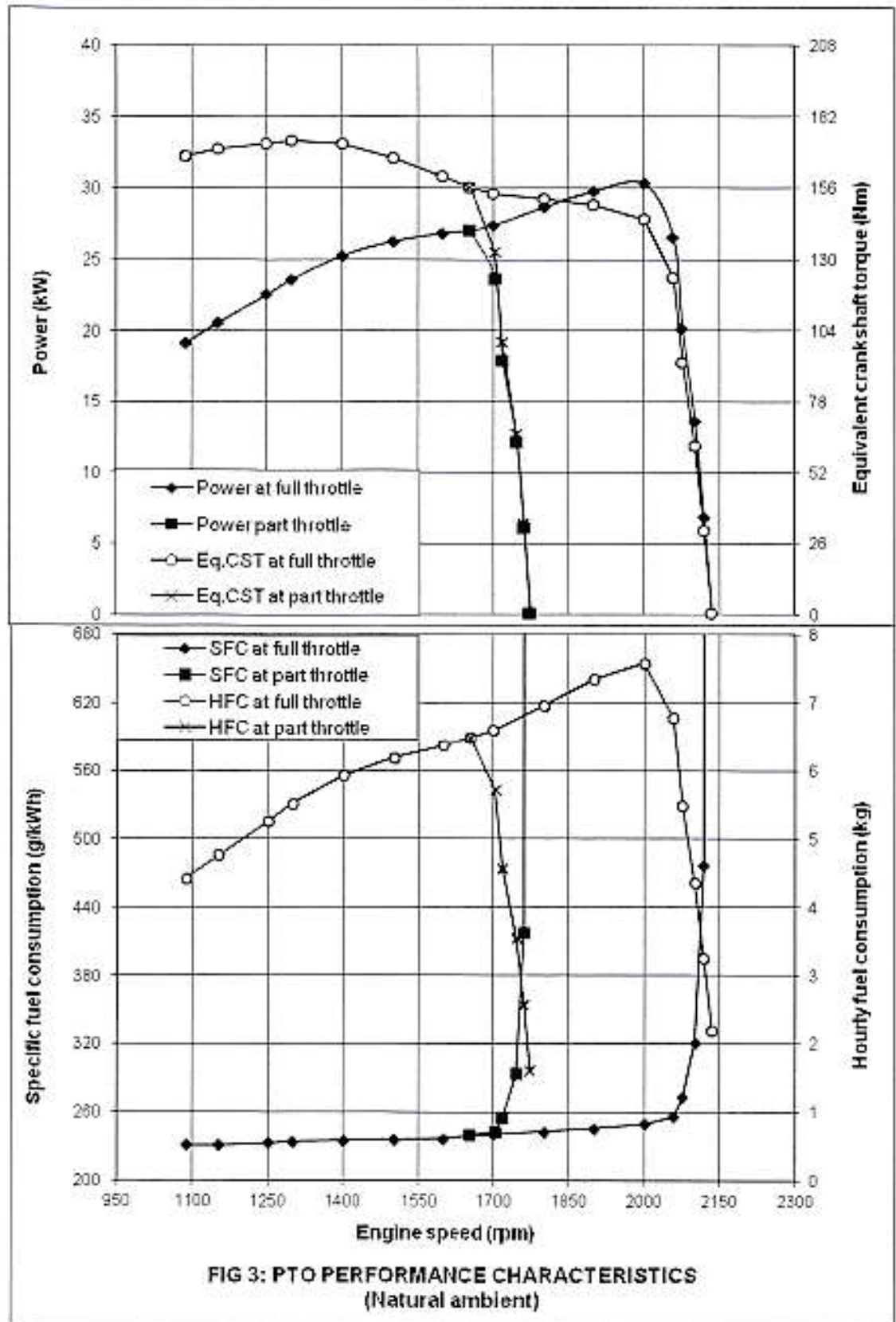
Type of dynamometer bench used : SAJ-AG 250 Eddy Current.

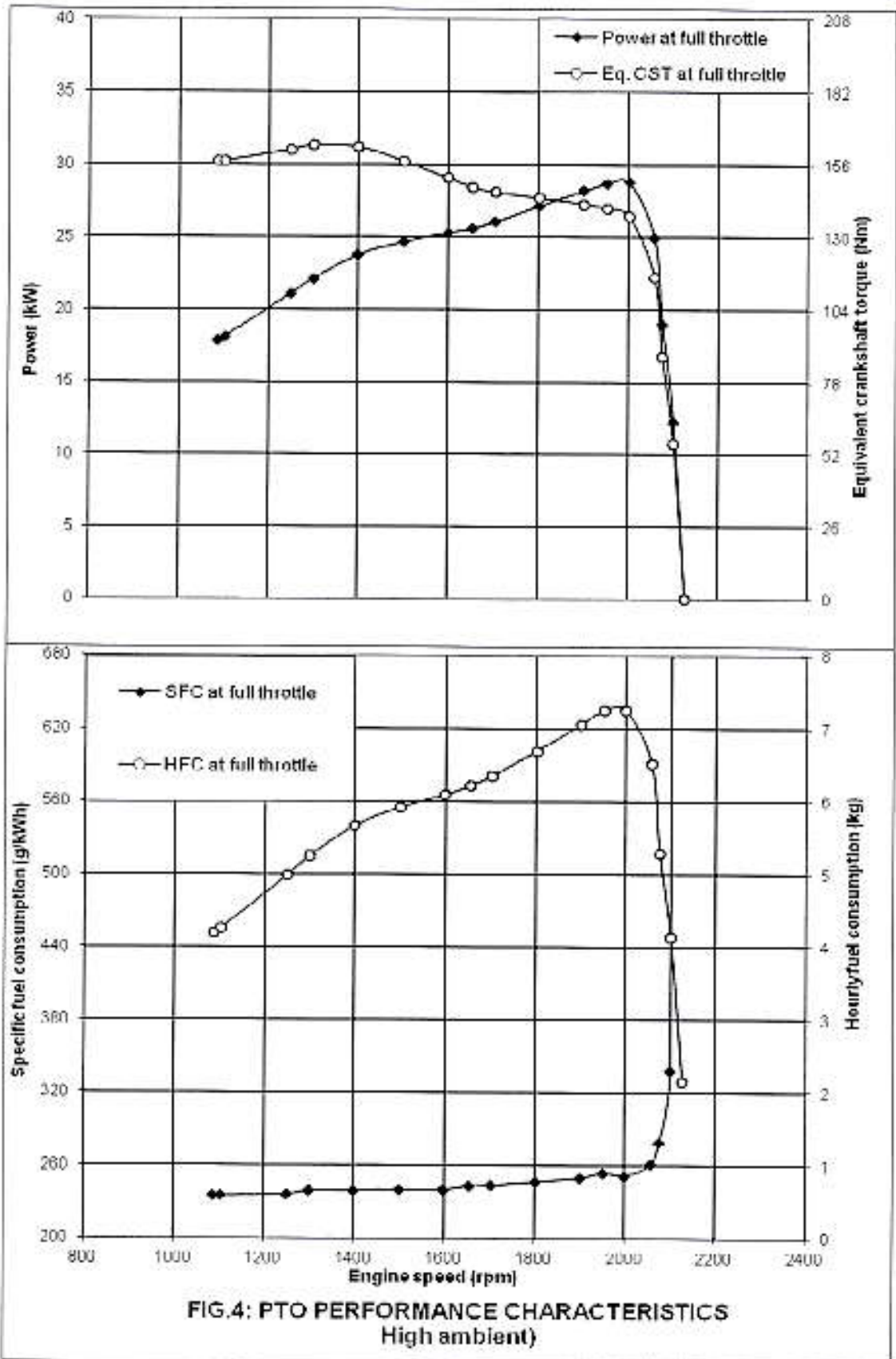
- 3.1 The results of power take-off performance are tabulated in Table-1 and graphically represented in Fig. 3, 4 and 5.

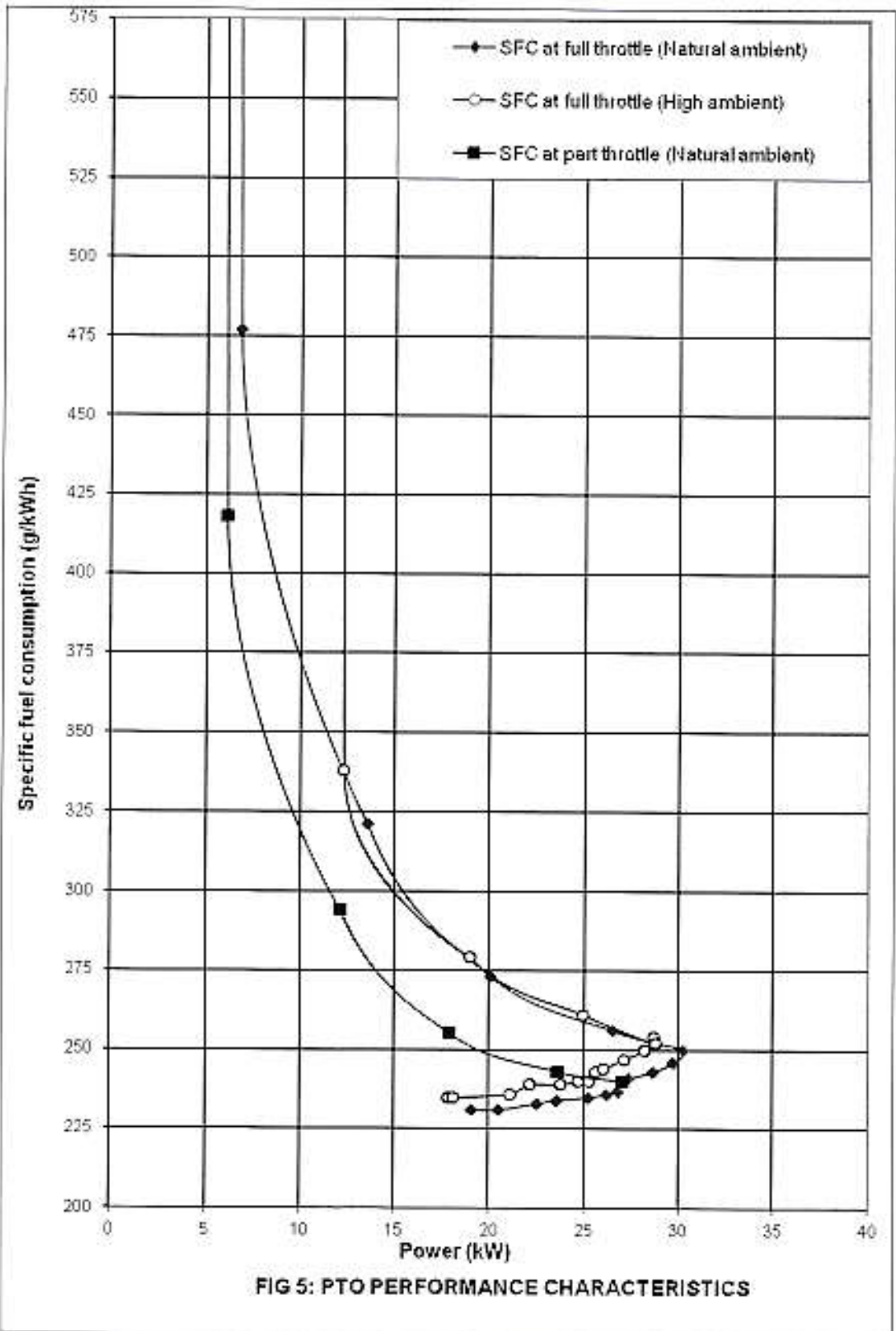
Table – 1

Power, (kW)	Speed (rpm)		Fuel consumption			Specific energy (kWh/l)
	PTO	Engine	(l/h)	(kg/h)	Specific, (kg/ kWh)	
1	2	3	4	5	6	7
a) Maximum power – 2 hours test:						
30.3	653	2000	9.07	7.58	0.250	3.34
28.8	653	2000	8.67	7.25	0.252	3.32*
b) Power at rated engine speed (2000 rpm):						
30.3	653	2000	9.07	7.58	0.250	3.34
28.8	653	2000	8.67	7.25	0.252	3.32*
c) Power at standard power take-off speed (540 ± 10 rpm):						
27.0	540	1654	7.76	6.49	0.240	3.48
25.6	540	1654	7.43	6.22	0.243	3.45*
d) Varying loads at rated engine speed:						
i) Torque corresponding to maximum power available at rated engine speed:						
30.3	653	2000	9.07	7.58	0.250	3.34
ii) 85% of the torque obtained in (i):						
26.5	672	2058	8.12	6.78	0.256	3.26
iii) 75% of the torque obtained in (ii) :						
20.1	678	2076	6.56	5.49	0.273	3.06
iv) 50% of the torque obtained in (ii) :						
13.6	686	2101	5.22	4.36	0.321	2.61
v) 25% of the torque obtained in (ii) :						
6.8	692	2119	3.88	3.25	0.478	1.75
vi) Unloaded:						
0.1	697	2135	2.61	2.19	21.900	0.04
e) Varying loads at Standard PTO Speed:						
i) Torque corresponding to maximum power available at standard PTO speed: (540 ± 10 rpm):						
27.0	540	1654	7.76	6.49	0.240	3.48
ii) 85% of the torque obtained in (i) :						
23.6	556	1703	6.86	5.73	0.243	3.44
iii) 75% of the torque obtained in (ii) :						
17.9	561	1718	5.47	4.57	0.255	3.27
iv) 50% of the torque obtained in (ii):						
12.1	570	1746	4.26	3.56	0.294	2.84
v) 25% of the torque obtained in (ii) :						
6.1	575	1761	3.07	2.57	0.421	1.99
vi) Unloaded:						
0.1	579	1773	1.93	1.61	16.100	0.05

* Under high ambient conditions









Sl. No.	Parameters	Natural Ambient	High Ambient
i)	No load maximum speed, (rpm)	2135	2128
ii)	Equivalent crankshaft torque at maximum power (Nm)	144.6	137.6
iii)	Maximum equivalent crank shaft torque (Nm)	173.4	162.9
iv)	Engine speed at maximum equivalent crankshaft torque, (rpm)	1299	1299
v)	Backup torque (%)	19.9	18.4
vi)	Smoke level at 80 % of max. power	0.16	--
vii)	Range of atmospheric condition :		
	- Temperature, ($^{\circ}$ C)	27 to 30	41 to 44
	- Pressure, (kPa)	99.2 to 99.4	100.2 to 100.5
	- Relative humidity, (%)	44 to 48	18 to 30
viii)	Maximum Temperature, ($^{\circ}$C):		
	- Engine oil	92	100
	- Coolant	80	92
	- Fuel	45	60
	- Air intake	28	44
	- Exhaust gas	491	501
ix)	Pressure at maximum power:		
	- Intake air, (kPa)	3.0	2.9 to 3.0
	- Exhaust gas, (kPa)	4.9 to 6.5	6.1 to 6.8
x)	Consumptions:		
	Lub. Oil (g/kWh)	--	0.574
	-Coolant (% of total coolant capacity)	--	Nil

4. DRAWBAR PERFORMANCE TEST

Date(s) of test	: 05.06.2017, 06.06.2017, 07.06.2017 & 09.06.2017
Tractor run at the Institute prior to start of drawbar performance test, (h)	: 39.87
Type of track	: Concrete
Height of drawbar, (mm):	
- With standard ballast	: 660
- With ballast	: 530

4.1 The results of drawbar performance test consisting of maximum power and pull without ballast, with ballast and ten hours test are tabulated in **Table – 2** The results of the tests with ballast, are also represented graphically in **Fig. 6 & 7**.



Table - 2

DRAWBAR PERFORMANCE TEST

Gear	Travel Speed, (km/h)	Draw-bar power, (kW)	Draw-bar pull, (kN)	Engine Speed, (rpm)	Wheel Slip, (%)	Fuel consumption		Specific Energy, (kWh/l)	Atmospheric conditions				Temperature (°C)			Max. sustained pull, (kN)
						(kg/kWh)	(l/h)		Temp (°C)	Pressure (kPa)	R.H. (%)	Fuel	Transmit	Coolant (water)	Eng. oil	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
i) Maximum power test (Tractor unballasted):																
L1	2.54	12.2	17.25	2084	15.1	0.307	5.65	2.16	31	98.3	55	39	59	77	87	18.04
L2	3.30	15.8	17.25	2071	14.9	0.357	6.75	2.34	30	98.4	57	37	58	78	87	17.49
L3	5.60	24.0	15.44	1995	9.9	0.315	9.04	2.65	28	98.4	68	34	55	79	86	17.67
L4	8.56	25.3	10.62	1949	6.1	0.298	9.02	2.80	27	98.4	62	33	52	79	81	13.20
H1	9.33	26.4	10.19	2008	5.3	0.287	9.06	2.91	26	98.5	62	33	39	78	81	11.36
ii) Maximum power test (Tractor ballasted):																
L1	2.49	15.6	22.66	2073	14.8	0.356	6.69	2.28	29	98.6	74	36	61	78	87	24.78
L2	3.24	21.4	23.78	2056	14.7	0.333	8.52	2.51	27	98.7	68	34	59	78	85	24.72
L3	5.72	24.8	15.69	2002	7.1	0.307	9.11	2.72	25	98.7	61	32	56	79	86	18.83
L4	8.64	25.6	10.65	2001	4.1	0.304	9.31	2.75	25	98.7	72	32	55	78	84	13.07
H1	9.31	26.6	10.26	2001	4.0	0.287	9.13	2.91	25	98.6	70	31	50	78	83	11.94

Table-2 Contd..



Contd..Table-2

Gear	Travel Speed, (km/h)	Draw-bar power, (kW)	Draw-bar pull, (kN)	Engine Speed, (rpm)	Wheel Slip, (%)	Fuel consumption		Specific Energy, (kWh/l)	Atmospheric conditions			Temperature, (°C)			Max. sustained pull, (kN)	
						(kg/kWh)	(l/h)		Temp (°C)	Pressure (kPa)	R.H. (%)	Fuel	Trans. oil	Coolant (water)		Eng. ing. oil
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
iii) Five hours test at 75 percent of pull obtained at max. Power (ballasted wheeled tractor):																
L3	6.01	19.5	11.68	2063	5.6	0.325	7.69	2.54	25 to 30	98.1 to 98.2	60 to 81	32 to 38	39 to 78	76 to 78	82 to 98	--
iv) Five hours test at pull corresponding to 15 percent wheel slip (ballasted wheeled tractor):																
L2	3.21	21.2	23.79	2049	15.3	0.332	8.61	2.47	29 to 34	97.9 to 98.2	47 to 59	37 to 44	78 to 81	76 to 81	88 to 91	--

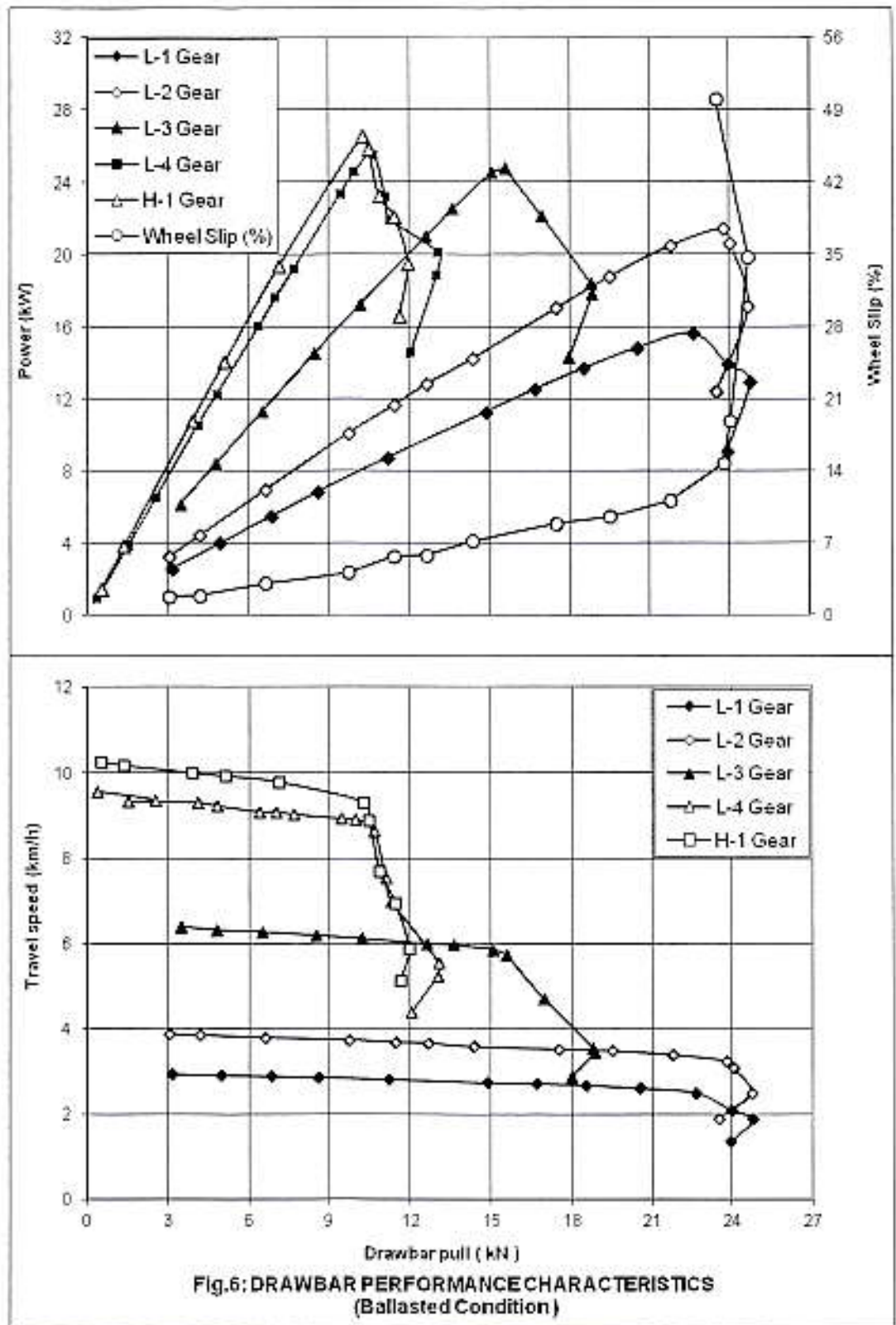
i) The coolant (water) and lub oil consumption during 10 hours test were observed as 5.0 ml/h and Nil respectively.

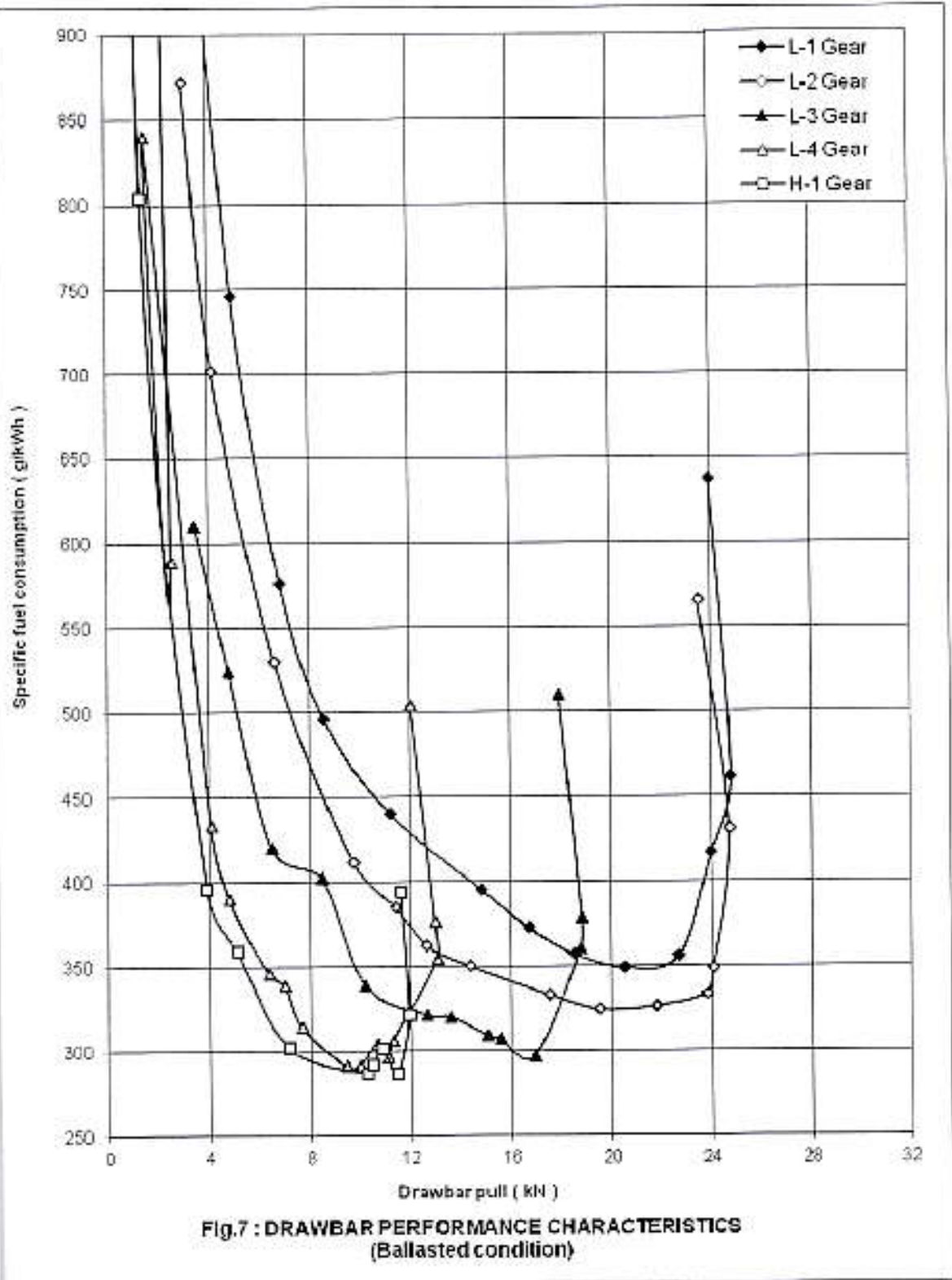
ii) Tyre Creeping, (mm):

- LHS : 30
- RHS : 55

iii) Maximum temperatures during entire drawbar test, (°C):

Engine oil : 91
Coolant (water) : 84
Transmission oil : 81
Fuel : 44







5. POWER LIFT & HYDRULIC PUMP PERFORMANCE TEST

Date(s) of test : 11.04.2017 & 12.04.2017
 Tractor run at the Institute prior to start of : 21.2
 hydraulic test, (h)
 Pump speed at rated engine speed (rpm) : 2000

5.1 Hydraulic power test:

Pump delivery rate at minimum pressure : 28.5
 and rated engine speed, (l/min)
 Maximum hydraulic power, (kW) : 6.6
 Pump delivery rate at maximum hydraulic : 29.3
 power, (l/min)
 Pressure at maximum hydraulic power, : 13.5
 (MPa)
 Sustained pressure of the open relief : 16.5
 valve, (MPa)

Tapping point:

a) Relief valve test : External circuit
 b) Pump performance test : Pump outlet
 Temperature of hydraulic fluid, (°C) : 60 to 62

5.2 Lifting capacity test :

Test	Height of lower hitch point above ground in down position, (mm)	Vertical movement with lifting forces, (mm)	Maximum corrected force exerted through full range, (kN)	Corresponding pressure, (MPa)	Moment about rear axle, (kN-m)	Maximum tilt angle of mast from vertical (degrees)
At hitch points	200	635	16.71	14.85	11.19	—
On the standard frame	200	640	11.32	14.85	14.49	20.1

5.3 Maintenance of lift load:

Force applied at the frame, (kN) : 10.20
 Temperature of hydraulic fluid at the : 60
 start of test, (°C)

Test data:

Elapsed time (minute)	5	10	15	20	25	30
Cumulative drop in height of lift, (mm)	10	24	30	52	62	72



6. BRAKE TEST

6.1 Service brake:

6.1.1 Cold brake test:

Date of test(s)	: 10.01.2017 & 06.01.2017
Type of Track	: Concrete
Maximum attainable speed (kmph):	
-Without Ballast	: 33.0
-With Road Ballasted	: 33.0

		At maximum attainable speed			
Unballasted tractor	Braking device control, force (N)	501	400	300	200
	Mean deceleration, (m/sec ²)	3.58	3.35	3.09	2.50
	Stopping distance, (m)	11.87	12.54	13.62	16.81
Road ballasted tractor	Braking device control force(N)	503	405	307	209
	Mean deceleration, (m/sec ² .)	3.46	3.33	2.97	2.50
	Stopping distance, (m)	12.15	12.62	14.15	16.81
		At 25 kmph travel speed			
Unballasted tractor	Braking device control, force(N)	533	420	307	193
	Mean deceleration, (m/ sec ²)	3.40	3.14	2.79	2.50
	Stopping distance, (m)	7.19	7.68	8.65	9.65
Road ballasted tractor	Braking device control force,(N)	502	705	308	211
	Mean deceleration, (m/sec ²)	3.36	3.06	2.78	2.50
	Stopping distance, (m)	7.39	7.88	8.69	9.65

6.1.2 Brake fade test:

		At maximum attainable speed			
Braking device control force (N)		527	436	346	256
Mean deceleration, (m/ sec ²)		3.59	3.30	3.00	2.50
Stopping distance, (m)		12.21	12.74	14.02	16.81
		At 25 kmph travel speed			
Braking device control force,(N)		528	431	334	237
Mean deceleration, (m/ sec ²)		3.23	3.04	2.81	2.50
Stopping distance, (m)		7.48	7.94	8.58	9.65

Maximum deviation of tractor from its original course, (m)	: None
Abnormal vibration	: None
The brakes were heated by	: Self braking

6.2 Parking brake test:

Particulars	18 percent slope		12 percent slope with trailer of 2.08 tones.	
	Up	Down	Up	Down
Braking device control force, (N)	309	343	298	334
Efficacy of parking brake	-----Effective-----			



7. NOISE MEASUREMENT

7.1 Noise at bystander's position:

Date of test	: 13.01.2017
Type of track	: Concrete
Background noise level, dB (A)	: 54.5
Atmospheric conditions:	
Temperature, (°C)	: 25
Pressure, (kPa)	: 97.7
Relative humidity, (%)	: 35
Wind velocity, (m/s)	: 2.7

TEST DATA:-

S. No.	G e a r	Travelling speed before acceleration, (kmph)	Noise level, dB (A)
1.	L1	2.26	82
2.	L2	3.00	83
3.	L3	4.91	83
4.	L4	7.20	83
5.	H1	7.72	82
6.	H2	10.24	82
7.	H3	16.94	82
8.	H4	24.73	81

7.2 Noise at operator's ear level:

Date of test	: 06.06.2017
Type of track	: Concrete
Background noise level, dB(A)	: 54.1
Atmospheric conditions:	
Temperature, (°C)	: 31
Pressure, (kPa)	: 98.3
Relative humidity, (%)	: 59
Wind velocity, (m/s)	: 1.0

TEST DATA:

Gear	Drawbar pull at which the tractor develops the maximum noise level, (kN)	Corresponding travelling speed, (kmph)	Noise level dB (A)
L1	13.95 to 17.24	2.71 to 2.54	93
L2	17.11	3.33	93
L3	12.41 to 15.31	5.94 to 5.61	94
L4*	4.81 to 10.57	9.35 to 8.58	93
H1	4.24 to 10.19	10.04 to 9.27	93

* Gear corresponds to the nominal travelling speed nearest to 7.5 kmph.



8. AIR CLEANER OIL PULL-OVER TEST

Date of test : 19.01.2017

Tractor run at the Institute prior to start of air cleaner oil pull-over test, (h) : 3.53

Atmospheric conditions:

Temperature, (°C) : 22 to 32

Pressure, (kPa) : 97.8 to 98.1

Relative humidity, (%) : 29 to 61

Mass of oil before test, (g) : 675.3

Sl. No	Position of tractor	Loss of oil (g)	Oil pull-over (%)	Engine oil pressure
i)	Tractor parked on level ground	0.70	0.10	Normal
ii)	Tractor tilted 15° laterally on RHS*	Nil	Nil	Normal
iii)	Tractor tilted 15° laterally on LHS*	Nil	Nil	Normal
iv)	Tractor tilted 15° longitudinally with front end up	0.10	0.01	Normal
v)	Tractor tilted 15° longitudinally with rear end up	Nil	Nil	Normal

9. MECHANICAL VIBRATION MEASUREMENT

Date of test : 15.02.2017

Type of test surface : Concrete

Sl. No.	Measuring points	Vibration, microns				
		At no load		At load corresponding to 85% of maximum PTO power		
		HD	VD	HD	VD	
i)	Foot rest	Left	40	90	120*	110*
		Right	220*	240*	170*	190*
ii)	Steering control wheel	90	40	250*	100	
iii)	Seat	Bottom	20	30	40	50
		Back	30	30	90	20
iv)	Mudguard	Left	70	60	120*	190*
		Right	220*	70	180*	230*
v)	Head light	Left	50	40	110*	130*
		Right	60	40	100	130*
vi)	Battery base, centre	240*	480*	190*	160*	
vii)	Tail light	Left	130*	60	300*	160*
		Right	100	190*	310*	520*
viii)	Plough light	190*	160*	380*	190*	
ix)	Gear shifting lever	60	70	80	60	
x)	Accelerator lever	Hand	140*	100	220*	190*
		Foot	150*	60	180*	190*
xi)	Brake pedal	Left	60	160*	70	140*
		Right	120*	190*	200*	150*
xii)	Clutch pedal	120*	70	130*	80	
xiii)	Main hydraulic control lever	60	60	50	30	
xiv)	PTO engaging lever	40	70	70	190*	

*The amplitude of mechanical vibration is on higher side.



10. LOCATION OF CENTRE OF GRAVITY

Condition	Particulars	Coordinates
Tractor under unballasted condition but with all the liquid reservoirs full & the operator replaced by a 75 kg mass on the seat	Height above ground, (mm)	765.5
	Distance forward from the vertical plane containing the axis of rear wheels, (mm)	775.3
	Distance from the median plane parallel to the longitudinal axis of tractor bisecting the track, (mm)	16.6 (towards RHS)

11. TURNING ABILITY

Characteristics	Minimum turning diameter, (m)		Minimum clearance diameter, (m)	
	LHS	RHS	LHS	RHS
Brakes released	7.24	7.06	7.44	7.29
Brake applied	6.41	6.39	6.63	6.59

12. FIELD TEST

- 12.1 The field tests comprising of Disc ploughing, Rotavation and Wet land cultivation (including puddling and water proof) were conducted for 11.50, 11.85 and 15.34 hours respectively. All the field tests were conducted at the full accelerator settings, when the no load speed of the engine varied from 2138 to 2144 rpm.
- 12.2 The brief specifications of the implements used during field tests are given in **Annexure – I**
- 12.3 The summary of field test observation with Disc plough, rotavator and half cage wheel with puddler are given in **Table – 3**.

Table – 3

SUMMARY OF FIELD PERFORMANCE TEST

S No.	Parameter/operation	Disc Ploughing	Rotavation	Puddling
i)	Type of soil	Light	Light	Heavy
ii)	Av. Soil moisture, (%) / Av. Depth of water, (cm)	7 to 8	6 to 8	10 to 15
iii)	Bulk density of soil, (g/cc)	1.90 to 1.96	1.7 to 2.0	--
iv)	Cone index, (kg/cm ²) / Puddling index, (%)	6.30 to 7.32	6.81 to 8.17	80.37 to 83.67
v)	Gear used	L-1	L-1	L-2
vi)	Av. Speed of operation, (kmph)	2.42 to 2.60	2.94 to 2.97	2.90 to 3.01
vii)	Av. Wheel slip / Av. Travel reduction, (%)	17.4 to 18.1	-0.16 to -0.01	9.17 to 15.98
viii)	Av. Depth of cut / depth of puddle, (cm)	22 to 26	7	22
ix)	Av. Working width, (cm)	89 to 95	149 to 156	--
x)	Area covered, (ha/h)	0.199 to 0.203	0.403 to 0.406	--
xi)	Fuel consumption;			
	- (l/h)	3.47 to 3.83	4.33 to 5.11	4.51 to 4.57
	- (l/ha)	17.44 to 18.87	10.67 to 12.68	--
xii)	Av. Draft of implement, (kN)	5.47	--	--

Remarks: The average lub oil and coolant (water) consumptions during the entire field tests were observed to be 1.48 ml/h & 4.45 ml/h respectively.

**12.4 Wet land cultivation (Puddling):**

12.4.1 The tractor was fitted with half cage wheel with puddler for conducting the puddling operation. The brief specification of puddler and half cage wheel used is given in Annexure -I & II respectively.

12.4.2 After completion of puddling test and water proof test, the tractor was partially dismantled to check effectiveness of sealing provided against ingress of water and / or mud in various assemblies / components as per requirements of IS : 11082 – 1984 (Technical requirement of Agriculture tractors for wet land cultivation). The observations recorded were as under.

S. No.	Location	Whether ingress of mud and/or water	Remarks
1.	King pin assemblies	No	None
2.	Stub axles	No	
3.	Centre pin assembly	No	
4.	Clutch housing	No	
5.	Lubricating oil in engine sump, air cleaner soil, transmission system, hydraulic, brake and steering system	No	
6.	Starter motor	No	
7.	Alternator	No	

13. HAULAGE TEST

Type of trailer	:	Two wheel (Single axle)	Four wheel (Double axle)
Gross mass of trailer (tonne)	:	5.0	6.0
Height of trailer hitch above ground level, (mm)	:	525	550
Gear used during the test for negotiating slopes up to 8%	:	H-4	H-4
Average travel speed, (kmph)	:	31.09 to 31.57	31.57
Average fuel consumption:			
- (l/h)	:	6.09 to 6.33	6.18 to 6.22
- (ml/km/tonne)	:	39.2 to 40.1	32.6 to 32.8
Average distance traveled per liter of fuel consumption, (km)	:	5.0 to 5.1	5.1
General observations:			
Effectiveness of brakes	:	Effective	Effective
Maneuverability of tractor-trailer combination	:	Satisfactory	Satisfactory

14. COMPONENTS/ASSEMBLY INSPECTION

The engine and other assemblies were dismantled after 103.9 hours of tractor operation at this Institute.

14.1 Engine:**14.1.1 Cylinder bore:**

Cylinder No.	Cylinder bore dia, (mm)						Max. permissible wear limit, (mm)
	Top position		Middle position		Bottom position		
	Thrust side	Non-thrust side	Thrust side	Non-thrust side	Thrust side	Non-thrust Side	
1.	110.035	110.030	110.038	110.022	110.048	110.024	110.225
2.	110.046	110.023	110.027	110.017	110.030	110.022	
3.	110.022	110.016	110.020	110.023	110.022	110.023	

**14.1.2 Piston:**

Piston No.	Piston dia. (mm)				Piston to cylinder liner clearance at skirt (mm)	
	Top (above top compression ring)		At skirt		As observed	Max. permissible limit.
	Thrust Side	Non-thrust Side	Thrust side	Non-thrust side		
1.	109.360	109.360	109.870	**	0.178	0.60
2.	109.350	109.360	109.860	**	0.186	
3.	109.360	109.370	109.870	**	0.153	

Remark (*) :- Not measured due to piston design.

14.1.3 Ring end gap:

Rings	Ring end gap, (mm)									Maximum Permissible limit, (mm)
	Cylinder No.1			Cylinder No.2			Cylinder No. 3			
	Top	Middle	Bottom	Top	Middle	Bottom	Top	Middle	Bottom	
1 st comp. ring	0.50	0.50	0.50	0.50	0.55	0.55	0.55	0.55	0.55	1.75
2 nd comp. ring	0.50	0.50	0.55	0.50	0.55	0.60	0.55	0.55	0.50	1.75
Oil ring	0.40	0.45	0.45	0.45	0.45	0.45	0.40	0.45	0.45	1.75

14.1.4 Ring side clearance:

Rings	Ring side clearance, (mm)			Maximum Permissible Limit, (mm)
	Piston-I	Piston-II	Piston-III	
1 st Compression ring	-----Tapered-----			--
2 nd Compression ring	0.081	0.075	0.092	0.25
Oil ring	0.067	0.067	0.059	0.25

14.1.5 Main bearings:

Bearing No.	Diametrical Clearance, (mm)	Crankshaft end float, (mm)	Maximum permissible limit, (mm)	
			Diametrical clearance	Crankshaft end float
1.	0.080 to 0.093	0.274	0.30	0.50
2.	0.087 to 0.102			
3.	0.102 to 0.104			
4.	0.081 to 0.099			

14.1.6 Big end bearings:

Bearing No.	Clearance, (mm)		Maximum permissible limit, (mm)	
	Diametrical	Axial	Diametrical	Axial
1.	0.109 to 0.136	0.25	0.30	0.60
2.	0.104 to 0.141	0.25		
3.	0.100 to 0.119	0.25		

14.1.7 Valve, guides and timing gears:	Observation
Any marked sign of overheating of valves	: None
Pitting of seat/faces of valves	: None
Any visual damage to the teeth of timing gears	: None



- Spring rate, (N/mm):**
 - Intake valve spring : 22.45 to 23.82
 - Exhaust valve spring: : 22.28 to 23.26
 Against discard limit of 9.8 N/mm
- Clearance between valve guide and valve stem, (mm):
 - Intake valve : 0.068 to 0.079
 - Exhaust valve : 0.073 to 0.077
 Against discard limit of 0.25 mm
- 14.2 Clutch:**
 Any marked wear on clutch friction plates : None
 Condition of clutch release bearing : Normal
 Condition of springs and release levers : Normal
 Condition of pilot bearing : Normal
 Presence of oil in clutch housing : None
 Any marks on fly wheel/ pressure plate : None
- Overall thickness of clutch plate, (mm):
 Transmission : 9.632 to 9.704
 PTO : 7.783 to 7.841
 Discard limit wear upto rivet head.
- Height of lining over rivet head, (mm):
 Transmission : 2.34 to 2.51
 PTO : 1.08 to 1.44
 Discard limit wear up to rivet head fauling.
- 14.3 Transmission gears:**
 Any visual damage, pitting & chipping of any transmission gear teeth : None
 Backlash between crown wheel and pinion, (mm) : 0.281
 Discard limit is not specified. However there is provision to adjust backlash through check nut and shims

14.4 Brakes:

Description	Initial specified thickness of brake lining, (mm)	Measured thickness of brake lining after test, (mm)	Height of brake lining over metal plate, (mm)	Minimum permissible height of brake lining above oil groove, (mm)
Left	4.75 ± 0.05	4.756 to 4.793	0.98 to 1.11	Wear till groove base
Right	4.75 ± 0.05	4.732 to 4.764	0.95 to 0.11	

14.5 Front axle:

- Any marked wear of king pins : None
 Any marked wear of king pin bushes : None
 Clearance between king pin and bushes, (mm) : 0.116 to 0.155
 Against the discard limit of 0.60 mm.
- Condition of bearings for stub axles : Normal
 Condition of king pin bearings : Normal
 Condition of seals for stub axles and king pins : Normal
- Clearance between centre pin and bushes, (mm) : 0.139 to 0.143
 Against the discard limit of 0.60 mm.



- 14.6 Steering system:**
Visual condition of the components of complete steering assembly : Normal
- 14.7 Starter motor & Alternator:**
Presence of soil/oil in housing : None
Condition of bearings and other components : Normal

15. ADJUSTMENTS, DEFECTS, BREAKDOWNS AND REPAIRS

Sl. No.	Adjustments/Defects/Breakdowns and Repairs	Tractor run hours
--	None	--

16. COMPARISON OF SPECIFICATION AND PERFORMANCE CHARACTERISTICS OF PREVIOUS SAMPLE (TEST REPORT No. T- 401/821 released on July, 2000 and report NO. T- 1114/1640/2017, released on November, 2017. AND PRESENT SAMPLE

16.1	Specification:	Previous sample	Present sample
16.1.1	Tractor:		
	Make	: Swaraj	Swaraj
	Model	: 744FE	744FE
16.1.2	Engine:		
	Make	: M/s Swaraj Egnines Ltd.	M/s Swaraj Egnines Ltd.
	Model	: RB 30 TR	RB 30 TR
	Bore/Stroke, (mm)	: 110 / 110	110 / 110
	Specified cubic capacity, (cc) (apa)	: 3136	3136
	Rated engine speed, (rpm)	: 2000	2000
16.1.2.1	Fuel system:		
	Make & model of fuel feed pump	: Bosch India & FP/KS22AD62 (apa), 9440030029 (apa)	Bosch India & FP/KS22AD62 (apa), 9440030029 (apa)
	Make & model of fuel filters	: Bosch, India & F 002 H20 105	Bosch, India & F 002 H20 105
	Make and model of fuel injection pump	: Bosch, India & F002 A0Z 469, PES3A90D320RS2000	Bosch, India & F002 A0Z 469, PES3A90D320RS2000
	Make & model of fuel injectors	: Bosch, India & F002 C70 552	Bosch, India & F002 C70 552
	Type of injector	: Multi holes (four holes)	Multi holes (four holes)
	Manufacturer's production pressure setting, (MPa)	: 25.0 + 0.8	25.0 + 0.8
	Injection timing	: 13 ± 1 degree before TDC	13 ± 1 degree before TDC
	Make & model of governor	: Bosch, India & RSV375...1000A1C1 377R	Bosch, India & RSV375...1000A1C1377R
16.1.2.2	Lubricating system:		
	Total lubricating oil capacity, (l)	: 7.20	7.20



T- 1115/1641/2017		SWARAJ 744 FE- TRACTOR Commercial (Batch)	
16.1.3	Transmission:	<u>Previous sample</u>	<u>Present sample</u>
16.1.3.1	Clutch:		
	Type of clutch plate	Dual, Dry ,friction plates	Dry ,friction plate
	Size, OD/ID,(mm):		
	Transmission	279.63 / 165.70 Ø	279.63 / 165.70 Ø
	PTO	279.49 / 165.59 Ø	279.49 / 165.59 Ø
16.1.3.2	Gear Box:		
	No. of speeds:		
	- Forward	08	08
	- Reverse	02	02
	Range of speed, (kmph) :		
	- Forward	2.80 to 30.89	2.80 to 30.89
	- Reverse	3.31 to 11.45	3.31 to 11.45
16.1.4	Service Brake:		
	Make	JMIL	JMIL
	Type	Mechanical oil immersed multi discs	
	No. of friction disc	04 (on each wheel side)	04 (on each wheel side)
	Area of liners, (cm ²)	913.0 (on each wheel side)	913.0 (on each wheel side)
16.1.5	Wheel equipment:		
	Make & Size of tyres		
	- Front	Good Year	Good Year
	- Rear	Good Year	Good Year
	Standard Track width, (mm):		
	- Front	1330	1330
	- Rear	1420	1420
16.1.5.1	Wheel base, (mm)	2100	2100
16.1.6	Overall dimensions, (mm):		
	- Length	3470	3470
	- Width	1820	1820
	- Height (at steering wheel)	2240	2240
	- Ground clearance, (mm)	435 (front axle)	435 (front axle)
16.1.7	Operational mass of unallasted tractor(kg):		
	- Front	745	745
	- Rear	1325	1325
	- Total	2070	2070
16.1.8	Conformity with following IS:	<u>Previous sample</u>	<u>Present sample</u>
i)	Guide lines for declaration of power and specific fuel consumption and labeling of agricultural tractors (First revision) [IS 10273:1987 (Reaffirmed in March, 2009)]	Conformed	Conforms
ii)	Agricultural tractors – Rear mounted power take-off - Types 1, 2 and 3(third revision)[IS: 4931-1995 (Reaffirmed in March, 2009)]	Conformed	Does not conform
iii)	Agricultural wheeled tractors - Rear mounted three-point linkage: Part 1 Categories 1, 2, 3 & 4 (fourth revision) [IS 4468(Part-I):1997/ISO 730-1:1994 (Reaffirmed in March, 2009)]	Conformed	Conforms
iv)	Drawbar for agricultural tractors – Link type [IS 12953:1990 (Reaffirmed in March, 2007)]	Conformed	Conforms



		<u>Previous sample</u>	<u>Present sample</u>
v)	Agricultural tractors - Operator's seat technical requirement [IS 12343 -1998 (First revision) (Reaffirmed in March, 2009)]	Conformed	Conforms
vi)	Guide for safety & comfort of operator of agricultural tractors: Part 1 General requirements (first revision) : [IS 12239 (PT-1) 1996/ISO 4254-1:1989 (Reaffirmed in March, 2007)]	Did not conform	Does not conform
vii)	Tractors and machinery for agriculture and forestry, powered lawn and garden equipment - Symbols for operator controls and other displays [IS: 6283 (Part-1 & Part-2) -2006 & 2007 (Reaffirmed in March, 2009)]/ ISO 3767-2:1991]	Conformed	Conforms
viii)	Tractors and machinery for agriculture and forestry - Technical means for ensuring safety Part 2: Tractors (first revision) (IS 12239 (PT-2) 1999) (Reaffirmed in March, 2009)]	Did not conform	Does not conform
ix)	Guide lines for location and operation of operator controls on agricultural tractors and machinery (first revision) (IS: 8133 - 1983) (Reaffirmed in March, 2009)]	Conformed	Conforms
x)	Agricultural Tractor & Machinery Lighting device for travel on public roads (IS: 14683-1999) (Reaffirmed in March, 2009)]	Conformed	Conforms
16.2	Performance Characteristics:		
16.2.1	PTO Performance:		
	Maximum Power, (kW)	30.4 / 30.3	30.3
	Power at Rated engine speed, (kW)	30.4 / 30.3	30.3
	Specific fuel consumption corresponding to maximum power, (g/kWh)	255 / 250	250
	Maximum equivalent crankshaft torque, (Nm)	165.6 / 173.4	173.4
	Back up torque, (%)	13.9 / 19.9	19.9
	Maximum temperatures (degree):		
	Engine oil	106 / 100	100
	Coolant	107 / 92	92
	Lub oil consumption, (g/kWh)	1.02 / 0.57	0.57
16.2.2	Drawbar performance :		
	Maximum power with unballasted tractor, (kW)	26.8	26.4
	Maximum pull with unballasted Tractor, (kN)	15.5	17.25
	Maximum transmission oil temperature (deg. C)	85	81
16.2.3	Hydraulic performance:	<u>Previous Sample</u>	<u>Present Sample</u>
	Hydraulic pump discharge at minimum pressure and rated engine speed (l/min.)	18.50	28.50
	Maximum hydraulic power, (kW)	4.0	6.6
	Sustained pressure of the open relief valve, (MPa)	19.0	16.5



Maximum lifting capacity, (kN):	<u>Previous Sample</u>	<u>Present Sample</u>
- At the hitch point :	9.20	16.71
- At the standard frame :	8.26	11.32
Total drop in height of lift during load maintenance test, (mm) :	17	72

16.2.4 Brake performance test at 25 kmph speed (max).

Parameter	<u>Previous Sample</u>		<u>Present Sample</u>	
	Cold	Hot	Cold	Hot
Maximum Stopping distance, (m)	5.90 / 7.39	6.70 / 7.48	7.39	7.48
Maximum force exerted on the brake Pedal effort required to achieve deceleration of 2.5 m/sq sec, (N) :	172 to 185 / 211 to 237		211 to 237	
Weather parking brake is effective at a force of 600N at foot pedal (s) or 400 N at hand lever :	Effective		Effective	

16.2.5 Noise measurement:

- Maximum noise at bystanders position, dB(A) :	87	83
- Maximum noise at operator's ear level dB(A) :	99	94

16.2.6 Mechanical vibration:

Maximum amplitude of vibration at (microns):		
- Foot rest – LHS & RHS :	75 & 55	120 & 240
- Steering wheel :	280	250
- Driver's seat, (driver in seat): :	200	90

16.2.7 Haulage Test

	<u>Two wheel trailer</u>		<u>Two wheel trailer</u>	
	<u>Previous</u>	<u>Present</u>	<u>Previous</u>	<u>Present</u>
-Gross mass of trailer, (tonnes) :	5.0	5.0		
- Average speed, (kmph) :	23.25 to 27.43	31.09 to 31.57		
- Distance traveled per litre of fuel consumed, (km) :	5.02 to 5.22	4.98 to 5.10		
- Average fuel consumption (cc/km/tonne) :	38.3 to 36.7	39.2 to 40.1		

16.3 Qualifying performance (comparable limit) for batch model in comparison to ICT model (please refer Clause 7.6 of IS: 12207-2014):

S. No.	Characteristic	Requirements as per IS: 12207-2014		As observed		Whether meets the requirement (Yes/No)
		Column 4 of Table-1	Clause 7.6	Previous sample	Present sample	
1	2	3	4	5	6	7
16.3.1 Drawbar performance:						
a)	Maximum drawbar pull with ballast corresponding to 15 percent wheel slip, (Kn)	Minimum 65% of static mass with ballast	The performance shall be within 7.5% of ICT or limit specified under Column 3 whichever is higher	21.0	23.78	No
b)	Maximum drawbar pull without ballast corresponding to 15 percent wheel slip, (Kn)	Minimum 65% of static mass of tractor without ballast		15.5	17.25	No



1	2	3	4	5	6	7	
c)	Maximum drawbar power without ballast, (Kw).	Minimum 80 % of PTO power as referred in SI No. i) a) of PTO performance in case of tractors having total static mass > 1500 kg Minimum 75 % of PTO power as referred in SI No. i) a) of PTO performance.		26.8	26.4	Yes	
d)	Maximum transmission oil temperature (°C)	The declared value should not exceed the maximum value specified by oil company		85	81	Yes	
16.3.2 Hydraulic performance:							
a) Maximum lifting capacity throughout the range of lift, (kN):							
	1)	At hitch points	[Tolerance of minus 10%]	The performance shall be within 7.5% of ICT or limit specified under Column 3 whichever is higher	9.20	16.71	No
	2)	With the standard frame	The lift capacity should at least be 24 kg/PTO kW. And it should be 21.5 kg/engine kW where the tractor is not provided with a PTO shaft		8.26	11.32	No
	b)	Maximum drop in the height of the point of application of the force after each 5 minutes interval for a total duration of 30 minutes, (mm)	The observed value should not exceed 50 mm		17	72	No

16.4 Salient Observations:**16.4.1 Laboratory test:****Previous Sample****16.4.1.1 PTO Performance Test:**

- i) The maximum PTO power was recorded as **30.4 kW** against the declaration of **29.4 kW**, which meets the requirement of IS: 12207-2014 with regard to tolerance limit.
- ii) The specific fuel consumption corresponding to maximum power was recorded as **255 g/kWh** against the declaration of **265 g/kWh**, which is within the tolerance limit of IS: 12207-2014.
- iii) The maximum equivalent crankshaft torque was recorded as **165.6 N-m** against the declaration of **165 N-m**, which is not within the permissible limit and hence, it does not meet the non – evaluative requirement of IS: 12207-2014. This should be looked into for necessary corrective action.
- iv) The backup torque is **13.9 %**.

Present Sample

- i) The maximum PTO power was recorded as **30.3 kW** against the declaration of **30.1 kW**, which meets the requirement of IS: 12207-2014 with regard to tolerance limit.
- ii) The specific fuel consumption corresponding to maximum power was recorded as **250 g/kWh** against the declaration of **265 g/kWh**, which is within the tolerance limit of IS: 12207-2014.
- iii) The maximum equivalent crankshaft torque was recorded as **173 N-m** against the declaration of **165 N-m**, which is not within the permissible limit and hence, it does not meet the non – evaluative requirement of IS: 12207-2014. This should be looked into for necessary corrective action.
- iv) The backup torque is **19.9 %**.
- v) There is PTO power drop of **4.95 %** from natural to high ambient condition. This should be looked into for necessary corrective action.



Previous Sample	Present Sample
<p>16.4.1.2 Drawbar Performance Test: i) The maximum drawbar power and pull under unballasted condition of the tractor was of the order of 82 % of the total weight which is considered normal</p>	<p>i) Maximum drawbar pull with and without ballast corresponding to 15 percent wheel slip, (kN) was recorded as 23.78 & 17.25 kN respectively against the minimum requirement of 17.92 & 13.20 kN respectively. Which meet the minimum requirement of IS: 12207-2014.</p> <p>ii) During ten hours drawbar test, creeping of LHS & RHS rear tyre over the rims was observed as 30 & 55 mm respectively. This should be looked into for necessary corrective action.</p>
<p>16.4.1.3 Hydraulic Performance Test: i) The Maximum drop in the height during maintenance of lift load test was recorded as 17 mm.</p>	<p>i) Maximum drop in the height during maintenance of lift load test was recorded as 72 mm against the maximum requirement of 50 mm. Which does not meet the requirement of IS: 12207-2014.</p>
<p>16.4.1.4 Noise Level Test: i) Noise at operator's ear level was measured as 99 dB (A) which is on higher side against warning and danger limits of 85 dB (A) and 90 dB (A) respectively specified by ILO for continuous exposure of eight hours per day. This calls for reduction in noise level to improve the operational comfort and safety.</p>	<p>i) Noise at operator's ear level was recorded as 94 dB (A) which is within the specified limits of IS: 12207 -2014.</p>
<p>16.4.1.5 Mechanical Vibration: i) The amplitude of mechanical vibration were on higher side especially at the steering control wheel, seat, hand accelerator lever, head light, plough light & brake pedal. This call for dampening down of vibration to improve the operational comfort and service and service life of components</p>	<p>i) The amplitude of mechanical vibration on various assemblies marked as (*) in Chapter - 9 of this test report is on higher side. This calls for dampening down of vibrations especially on LHS - RHS foot rest and steering control wheel to improve the operational comfort and service life of components.</p>
<p>16.4.1.6 Field and Haulage Tests: During field tests leakage of hydraulic oil from RV housing was observed, which was rectified by replacing 'O' ring (Pt. No. 280063). This calls for improving the quality of sealing rings being used at production level.</p>	<p>No such observation was noticed.</p>
<p>16.5 Adequacy of literature: Following combined literature of SWARAJ 744 FE tractor model was supplied with the test sample for reference during the test. a) Operator's manual b) Parts catalogue</p>	<p>Following combined literature of SWARAJ 744 FE tractor model was supplied with the test sample for reference during the test. a) Operator's manual b) Parts catalogue c) Service manual</p>



17. SUMMARY OF OBSERVATIONS, COMMENTS & RECOMMENDATIONS

17.1 Evaluative (mandatory) / Non-evaluative (Non-mandatory) parameters applicable for qualifying Minimum Performance criteria as per Clause-4 (Table-1) of IS: 12207-2014 for acceptance of the tractor for the purpose of subsidies/NABARD financing are summarized as under:

Sl. No.	Characteristic	Category (Evaluative / Non Evaluative)	Requirements as per IS: 12207-2014	Values declared by the applicant/ (D) Requirement (R)	As observed	Whether meets the requirements (Yes/No)
1	2	3	4	5	6	7
17.1.1 PTO Performance :						
a)	Maximum power under 2 h test, (kW) (Natural ambient condition)	Evaluative	Declared value to be achieved with a tolerance of: -5 / +10% for PTO power >26 kW. -7.5/+10% for PTO power ≤ 26 kW or -5 / +10% for Engine power >26 kW, -7.5/+10% for Engine power ≤ 26 kW	30.1 (D)	30.3	Yes
b)	Power at rated engine speed, (kW)	Non Evaluative	-do-	30.1 (D)	30.3	Yes
c)	Specific fuel consumption corresponding to maximum power, (g/kWh)	Non Evaluative	+ 5%	265 (D)	250	Yes
d)	Maximum equivalent crankshaft torque, (Nm)	Non Evaluative	± 8%	165 (D)	173.4	Yes
e)	Back-up torque, percent	Non Evaluative	10 percent, min.	10 (D)	19.9	Yes
f)	Maximum operating temperature, (°C)					
	1) Engine oil	Non Evaluative	The declared value should not exceed the max. value specified by the oil company and the observed value under high ambient condition should not exceed the declaration.	130 (D)	100	Yes
	2) Coolant	Evaluative	The declared value should not exceed the boiling temperature of coolant under the pressurized or otherwise and the observed value under high ambient condition should not exceed the declaration.	115 (D)	92	Yes
g)	Engine oil consumption, (g/kWh)	Evaluative	Not exceeding 1% of SFC at max. power under High ambient conditions	2.52 Maximum (R)	0.57	Yes
h)	Smoke level, m ⁻¹	Evaluative	Maximum light absorption coefficient of 3.25 per meter or equivalent BOSCH No. 5.2 or 75 Hatridge value (As per CMVR)	3.25 Maximum (R)	0.16	Yes



1	2	3	4	5	6	7
17.1.2 Drawbar performance :						
a)	Maximum drawbar pull with ballast corresponding to 15 percent wheel slip, (kN)	Non Evaluative	Minimum 65% of static mass with ballast	21.0 (D) 17.92 (R) Minimum	23.78	Yes
b)	Max. drawbar pull with unballasted corresponding to 15 percent wheel slip, (kN)	Evaluative	Minimum 65% of static mass of tractor without ballast or with standard ballast, as the case may be	15.5 (D) 13.20 (R) Minimum	17.25	Yes
c)	Maximum drawbar power with standard ballast, (kW).	Evaluative	Minimum 60 % of PTO power as referred in SI No. i) a) of PTO performance in case of tractors having total static mass > 1500 kg Minimum 75 % of PTO power as referred in SI No. i) a) of PTO performance in case of light weight tractors having 1500 kg total static mass of tractor Minimum 75 % of the engine power as referred in SI No. i) a) of engine performance in case of tractors which do not have a PTO shaft.	26.8 (D) 24.2 (R) Minimum	26.4	Yes
d)	Maximum transmission oil temperature (°C)	Non Evaluative	The declared value should not exceed the maximum value specified by oil company	110 (D)	81	Yes
17.1.3 Power lift and hydraulic pump performance :						
a)	Maximum lifting capacity throughout the range of lift, (kN):					
	1) At hitch points	Non Evaluative	[Tolerance of minus 10%]	8.82 (D)	16.71	Yes
	2) With the standard frame	Evaluative	The lift capacity should at least be 24 kg/PTO kW. and it should be 21.5 kg/engine kW where the tractor is not provided with a PTO shaft	5.88 (D) 7.13 (R) Minimum	11.32	Yes
b)	Maximum drop in the height of the point of application of the force after each 5 minutes interval for a total duration of 30 Minutes, (mm)	Non Evaluative	The observed value should not exceed 50 mm	50 (D) Maximum	72	No
17.1.4 Brake performance at 25 kmph:						
a)	Maximum stopping distance at a force, equal to or less than 600 N on brake pedal with road ballast, (m):					
	1) Cold brake	Evaluative	10	10 (R)	7.39	Yes
	2) Hot brake	Evaluative	10	10 (R)	7.48	Yes
b)	Maximum force exerted on the brake pedal to achieve a deceleration of 2.5 m/s ² (N)	Evaluative	600	600 (R) Maximum	211 to 237	Yes



1	2	3	4	5	6	7
c)	Whether parking brake is effective at a force of 600 N at foot pedal (s) or 400 N at hand lever, N	Evaluative	Yes / No	Yes	343	Yes
17.1.5	Noise measurement :					
a)	Maximum ambient noise emitted by the tractor dB(A)	Evaluative	As per CMVR	88 (R)	83	Yes
b)	Maximum noise at operator's ear level dB(A)	Evaluative	As per CMVR	96 (R)	94	Yes
17.1.6	Amplitude of mechanical vibrations at:					
	1) Left foot rest	Non	100 microns (max)	100(R)	120	No
	2) Right foot rest	Evaluative			240	No
	3) Seat (with driver seated)				90	Yes
	4) Steering wheel				250	No
17.1.7	Air cleaner:					
	Air cleaner oil pull over, (%)	Non Evaluative	0.25 % (maximum)	0.25 % (maximum)	0.10	Yes
17.1.8	Haulage requirements :					
a)	Gross mass of the trailers, (tones):					
	1) Two wheel	Non	--	5.0 (D)	5.0	Yes
	2) Four wheel	Evaluative	--	6.0 (D)	6.0	Yes
b)	Distance travelled / liter of fuel consumption, (km/l):					
	1) Two wheel	Non Evaluative	--	5.0 to 7.0 (D)	5.0 to 5.10	Yes
	2) Four wheel		--	5.0 to 7.0 (D)	5.10	Yes
c)	Fuel consumption (ml/km/tonne):					
	1) Two wheel	Non	--	27 to 45 (D)	32.6 to 32.8	Yes
	2) Four wheel	Evaluative	--	27 to 45 (D)	39.2 to 40.1	Yes
17.1.9	Wetland cultivation :					
	Sealing for the following assemblies:	Evaluative	The identified assemblies should essentially meet the requirement of IS: 11082. No water ingress in the identified assembly given in column-2.If tractor does not meet the requirements of wetland cultivation, it may be recommended for dry land operation only.	There should be no ingress of water and/or mud (R)	No ingress of water and / or mud was observed	Yes
	1) Clutch assembly	-do-				
	2) Brake housings	-do-				
	3) Front axle hubs	-do-				
	4) Engine Oil	-do-				
	5) Transmissi on Oil	-do-				



1	2	3	4	5	6	7
17.1.9	Safety features :					
a)	Guards against moving and hot parts	Evaluative	Belt drives, pulleys, silencer, hydraulic pipes (As per IS 12239 (Part2))	--	Provided	Yes
b)	Lighting arrangement	Evaluative	As per CMVR	--	Provided	Yes
c)	Seating requirements (Tractors having more than 1150 mm rear track width)	Non Evaluative	Should meet the requirements of IS: 12343 (As amended from time to time)	--	Meets the requirements	Yes
d)	Technical requirements for PTO shaft	Non Evaluative	Should meet the requirements of IS: 4931 (As amended from time to time)	--	Does not meet the requirement	No
e)	Dimensions of three point linkage	Non Evaluative	Should meet the requirements of IS: 4468 (Part-I) (As amended from time to time)	--	Meet the requirements	Yes
f)	Specifications of linkage	Non Evaluative	Should meet the requirements of IS 12953 and IS 12362 (Part 3) (As amended from time to time)	--	Meet the requirements	Yes
	Swinging drawbar			--	Not Provided	--
17.1.10	Labelling of tractors (Provision of labelling plate):					
1)	Make	Evaluative	Should conform to the requirements of CMVR	--	Swaraj	Yes
2)	Model	Evaluative		--	744 FE	Yes
3)	Engine number	Evaluative		--	43.3009/SWN25 221	Yes
4)	Chassis number	Evaluative		--	WYCN4592295 7873	Yes
5)	Declaration of PTO power (kW)	Evaluative		--	30.1	Yes Yes

17.1.11	Discard limit for:					
(a)	Cylinder bore diameter, (mm)	Evaluative	To be specified by the manufacturer and supported by the printed literature	110.225 (D)	110.016 to 110.048	Yes
(b)	Clearance between piston & cylinder liner at skirt, (mm)	Non Evaluative		0.60 (D)	0.153 to 0.186	Yes
(c)	Ring end gap (mm):					
	- Top comp. ring.	Evaluative	-do-	1.75(D)	0.50 to 0.55	Yes
	- 2 nd comp. ring.		-do-	1.75(D)	0.50 to 0.60	Yes
- Oil ring.	-do-		1.75(D)	0.40 to 0.45	Yes	
(d)	Ring groove clearance (mm):					
	- Top comp. ring.	Evaluative	-do-	--Tapered--		--
	- 2 nd comp. ring.		-do-	0.25 (D)	0.075 to 0.092	Yes
- Oil ring.	-do-		0.25 (D)	0.059 to 0.067	Yes	
(e)	Clearance of main bearings (mm):					
	- Diametrical clearance	Evaluative	-do-	0.30 (D)	0.080 to 0.104	Yes
- Crankshaft end float	Evaluative	0.50 (D)		0.274	Yes	



1	2	3	4	5	6	7
(f)	Clearance of big end bearings, (mm):					
	- Diametrical	Evaluative	-do-	0.30 (D)	0.100 to 0.141	Yes
	- Axial	Evaluative	-do-	0.60 (D)	0.25	Yes
(g)	Clearance between king pin and bush, (mm)	Non Evaluative	-do-	0.60 (D)	0.116 to 0.155	Yes
(h)	Clearance between centre pin and bush, (mm)	Non Evaluative	-do-	0.80 (D)	0.139 to 0.143	Yes
17.1.12	Literature (Submission to test agency)					
(a)	Operator manual	Evaluative	Provided / Not Provided	Provided	Provided	Yes
(b)	Parts Catalogue	Evaluative	Provided / Not Provided	Provided	Provided	Yes
(c)	Workshop/ Service manual	Evaluative	Provided / Not Provided	Provided	Provided	Yes
17.1.13	CATEGORY OF BREAKDOWNS / DEFECTS :					
Sl. No.	Category of breakdowns	Category (Evaluative / Non Evaluative)	Requirements as per IS: 12207-2014	As observed	Whether meets the Requirements (Yes/No.)	
1.	Critical	Evaluative	No critical breakdown	None	Yes	
2.	Major	Evaluative	Not more than two and neither of them should be repetitive in nature	None	Yes	
3.	Minor	Evaluative	Not more than five and frequency of each should not be more than two.	None	Yes	
4.	Total breakdowns	Evaluative	In no case, the total number of breakdowns should exceed five, that is, (2 major + 3 minor) or 5 minor breakdowns.	None	Yes	
17.2	Optional requirements as per Clause-4 (Table-2) of IS:12207-2014:					
S.No.	Characteristic	Requirements as per IS: 12207-2014		As observed	Remarks	
1.	Fitment of ROPS	With a provision for fitment of ROPS.		Not provided	Not applicable	
		If ROPS fitted it should meet the requirement of IS: 11821 (As amended from time to time) or equivalent International Standards		ROPS not provided	Not applicable	
2.	Accessories	Trailer hitch, front tow hook, may be provided.		Provided	Yes	

17.3 Salient Observations:**17.3.1 Laboratory tests:****17.3.1.1 PTO Performance Test:**

- i) The maximum PTO power was recorded as **30.3 kW** against the declaration of **30.1 kW**, which meets the requirement of IS: 12207-2014 with regard to tolerance limit.
- ii) The specific fuel consumption corresponding to maximum power was recorded as **250 g/kWh** against the declaration of **265 g/kWh**, which is within the tolerance limit of IS: 12207-2014.
- iii) The maximum equivalent crankshaft torque was recorded as **173 N-m** against the declaration of **165 N-m**, which is within the permissible limit as specified in IS: 12207-2014.



- iv) The backup torque is 19.9 %.
- v) There is PTO power drop of 4.95 % from natural to high ambient condition. This should be looked into for necessary corrective action.

17.3.1.2 Drawbar performance test:

- i) Maximum drawbar pull with and without ballast corresponding to 15 percent wheel slip, (kN) was recorded as 23.78 & 17.25 kN respectively against the minimum requirement of 17.92 & 13.20 kN respectively. Which meet the minimum requirement of IS: 12207-2014.
- ii) Maximum drawbar power without ballast, was recorded as 26.4 kW, respectively against the minimum requirement of 24.2 kW. Which meet the minimum requirement of IS: 12207-2014.
- iii) During ten hours drawbar test, creeping of LHS & RHS rear tyre over the rims was observed as 30 & 55 mm respectively. This should be looked into for necessary corrective action.

17.3.1.3 Hydraulic performance test:

- i) Maximum lifting capacity throughout the range of lift at hitch point was recorded as 16.71 kN against the declaration of 8.82 kN. Which meet the requirement of IS: 12207-2014.
- ii) Maximum lifting capacity throughout the range of lift with standard frame was recorded as 11.32 kN against the minimum requirement of 7.13 kN. Which meet the minimum requirement of IS: 12207-2014.
- iii) Maximum drop in the height during maintenance of lift load test was recorded as 72 mm against the maximum permissible limit of 50 mm. Which does not meet the requirement of IS: 12207-2014. This should be looked into necessary corrective action against internal leakage of hydraulic fluid.

17.3.1.4 Mechanical Vibration:

The amplitude of mechanical vibration on various assemblies marked as (*) in Chapter – 9 of this test report is on higher side. This calls for dampening down of vibrations especially on LHS - RHS foot rest and steering control wheel to improve the operational comfort and service life of components.

17.3.1.5 PTO shaft:

The dimension "AØ" of PTO shaft does not meet the requirement of the IS: 4931 - 1995. This should be looked into for necessary corrective action.

17.3.1.6 Three point linkage:

Some of the parameters of three point linkage conform to Cat. I and some of them conform to Cat.II. Keeping in view the spirit of standardization, necessary improvement may be incorporated.

17.4 Maintenance / Service Problems:

No noticeable maintenance or service problem was observed during the test. Except there should be marking on timing gears for easy setting of fuel injection and valve opening timing

17.5 Recommendation with regard to safety on tractor:

The following requirements, inter alia, may be considered for incorporation on the tractor:

- i) There should be provision for spark arresting device in exhaust system.
- ii) There should be provision of differential lock.
- iii) Width of foot step is should be at least 200mm for easy ascending / descending on tractor
- iv) The working clearance between the position and draft control lever should be provided as per IS: 12239 (Part-2) – 1999.

**17.6 Adequacy of Literature supplied with machine:**

17.6.1 Literature was supplied with the tractor for reference during the test.

- a) Operator's manual of tractor model **SWARAJ 744 FE**.
- b) Parts catalogue of tractor model **SWARAJ 744 FE**.
- c) Service Manual of tractor model **SWARAJ 744 FE**.

17.6.2 The supplied literature was found adequate; except the following

- a) If tractor is fitted permanently with oil immersed brake then information related to dry type should not be provided in operator's and service manual. It should be taken as necessary corrective action.

However, these literatures should be brought out in other vernacular languages of India for guidance of users

18. Citizen charter

Duration of Test	Time frame for testing & evaluation as per citizen charter	Whether the report released within time frame given in the citizen charter	Remark
11 Months (December, 2016 to October, 2017)	10 Months	No	Due to seasonal constraint

TESTING AUTHORITY:

RAJNEESH PATEL
AGRICULTURAL ENGINEER

Y.K.RAO
SENIOR AGRICULTURAL ENGINEER

J.J.R. NARWARE
DIRECTOR

The report compiled by: Shri **Rajneesh Patel**, Agricultural Engineer.

19. APPLICANT'S COMMENTS

Para No.	Our Reference	Applicant's comments
--None--		

**ANNEXURE-I****BRIEF SPECIFICATION OF IMPLEMENTS USED DURING FIELD TEST**

S. No.	Parameters	Disc Plough	Rotavator	Puddler
1	Make	Fieldking	ACE	Not available
2	Type	Mounted	Mounted	Mounted
3	No. of Discs / Blades	Two	36 in 6 flanges	12 (6 in 2 gangs)
4	Type of Discs / Blades	Plain concave	Hatchet	Notched
5	Size of Discs / Blades (mm)	250	130 x 115 x 7	460
6	Spacing of Discs /Flanges. (mm)	510	210	165
7	Lower hitch point span, (mm)	825	750	680
8	Mast height, (mm)	570	640	450
9	Overall Dimensions (mm):			
	Length	2010	620	1190
	Width	1335	1760	1810
	Height	1200	1130	1330
10	Gross Mass, (Kg)	350	345	210

ANNEXURE-II**BRIEF SPECIFICATION OF HALF CAGE WHEEL**

S. No.	Parameters	Specification
1	Type	Half cage wheel
2	Outer dia. (mm)	1800
3	Width (mm)	355
4	No. & Type of Lugs	12, straight lugs made of MS angle section welded to angle iron frame
5	Size of angle section, (mm)	50 x 45 x 5
6	Length of lug, (mm)	350
7	Spacing of lug, (mm)	205
8	Weight of each cage wheel (kg)	100

**ANNEXURE - III****TRACTOR RUN HOURS DURING TEST**

A.	LABORATORY AND TRACK TESTS	HOURS
1.	Running-in	--
2.	PTO performance test	12.30
3.	Power lift and hydraulic pump performance test	1.41
4.	Drawbar performance test	14.28
5.	Brake test	2.08
6.	Noise measurement	1.50
7.	Mechanical vibration test	0.66
8.	Nominal speed test	0.56
9.	Air cleaner oil pull overt test	3.50
B.	FIELD TEST:	
1.	Disc ploughing	11.50
2.	Rotavation	11.85
3.	Wetland cultivation (including water proof)	15.34
C	HAULAGE TEST	5.26
D.	Miscellaneous test and other run hours including idle run, transportation, trials and preparation for test	23.70
TOTAL:		103.94